A COMPARISON OF PACING AND FREEHAND RAPID READING INSTRUCTION IN BRAILLE...

G. Howell, 1976

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A COMPARISON OF PACING AND FREEHAND RAPID READING INSTRUCTION IN BRAILLE ON READING RATE AND COMPREHENSION OF SCHOOL AGE BLIND CHILDREN

A Dissertation
Presented to the
Department of Educational Psychology
Brigham Young University

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Education

by

George Gary Howell

December 1976

This dissertation, by George Gary Howell, is accepted in its present form by the Department of Educational Psychology of Brigham Young University as satisfying the dissertation requirement for the degree of Doctor of Education.

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Chapter 1

BACKGROUND

A primary requisite in our present culture is the ability to read, since much of the material encountered in daily living is written or printed information. The understanding of written language requires the identification of specific symbols which are arranged in numerous combinations to form words. Meaning comes from groups of words or phrases and not single words (Wheeler, 1967). In this manner information is assimilated for present and future utilization.

Normally the years spent in school provide the opportunity for learning to read. The large majority of students acquire this ability to a greater or lesser degree. Whether for pleasure, knowledge or critical understanding, the person that reads with high comprehension has a marked advantage. Young people have difficulty obtaining jobs without proper training, and without reading ability it is hard to get the necessary training.

The Problem

Those students with severe visual impairments and who use braille as their basic reading media are doubly limited. Learning braille is a slow and tedious process requiring patience and perseverance. Once learned, the rate of assimilating information is much slower than reading print. Lowenfeld and Abel (1967) in an investigation of methods of teaching braille reading, reported the highest mean

braille reading rates to date. Considering residential and public school visually handicapped students together, their average reading rate in braille was 78 words per minute (WPM) at the fourth grade level and 133 WPM at the eighth grade level. These rates were substantially lower than the reading rates reported for sighted students by Taylor (1960), Harris (1961) and Miller (1967). These sources averaged together indicated that the reading rate for sighted students was approximately 154 WPM at the fourth grade level and 218 WPM at the eighth grade level.

Instruction to increase the reading rate of the sighted has received considerable attention in the past. Special instruction in speed reading is available at many colleges and universities. There is disagreement expressed in the literature regarding the rate at which individuals can read. Spache (1962) stated that it is physiologically impossible to read faster than 800 to 900 WPM. Adams (1969) reported the results of research using the Reading Eye Machine, a photographic device which records the movement of the eyes while reading. Approximately 900 WPM was established as the maximum reading rate for the normal reading process. According to Waldman (1972), ". . . the upper limit of speed in reading phrase by phrase or line by line is about 800 (but certainly not over 900) WPM (p. 144)." Reading speeds much higher than this have been reported, sometimes upwards of 2000 WPM. Stevens and Orens (1963) in disputing Spache (1962) said that rapid readers could read routine material faster than 1500 WPM, but first they must have a conceptual background in the material. Wood (Taylor, 1962) claimed that an easy novel could be read at 5000 WPM and technical material at 2500 WPM.

In analyzing the present situation for high school age braille readers, Umsted (1970) stated:

> Apparently, educators have erroneously assumed that by the time a braille reader reaches high school, he has achieved his optimum capacity for reading speed and accuracy. Possibly because of the demands of the high school curriculum, and the lack of previous research and materials, little demand or effort has been made to insure the maximum reading speed has been attained through drill in accuracy and speed or recognition of the braille code members. Some students with sufficient desire and drive develop their own approach for increasing reading speed, but a concentrated period of intensive study . . . would possibly be much more efficient (p. 40-41).

Rapid reading techniques have been applied to braille by McBride (1974), Wallace (1973), and Crandell and Wallace (1974). Their experiments have been successful in significantly increasing the braille reading rates for subjects from 16 to 50 years of age with little or no loss of comprehension. A self-learning device has been used by Flanigan (1966) to significantly increase the braille reading rates of 15 subjects. Kedris, Nolan and Morris (1967) used a controlled rapid exposure device and a variable-speed pacing device with no significant differences except for motivational aspects. Further research to increase the reading rate of school age children has been recommended.

Much research has been done with the electroencephalograph (EEG) and the measurement of the electrical activity of the brain. Attempts have been made to relate brain rhythm to intelligence or personality. It was hoped that new understandings of mind and brain relationships in humans would result. These studies for the most part were disappointing but have persisted. Novikova (1973) and her colleagues performed a series of investigations in Russia with visually

handicapped individuals and EEGs beginning in 1958 and extending to 1967. In studying the EEGs of the blind, it is important to account for those changes which are caused by damage to the eyes. Novikova (1973) stated, "We discovered that a full and prolonged exclusion of the flow of visual afferentation brings about distinct changes in the electrical activity of the cortex (p. xvi)." It was found that 83 percent of her subjects classified as totally blind had no alpha rhythm. Total blindness was also characterized by a lowering of the amplitude of electrical oscillations. Most of the electrical activity for those without visual acuity was in the central areas of the cortex.

Recently Inouye and Brown (1975, personal communication) have compared EEGs of sighted individuals with and without rapid reading abilities. The difference between regular and rapid reading functions in the brain may depend upon hemispheric dominance. In regular reading the left hemisphere analyzes the input, but in rapid reading the more efficient right hemisphere may assume the integrating process.

The Purpose

Since the reading of braille is slow at best, the application of rapid reading techniques by school age blind children would enhance their educational competitiveness. "Any means that would increase the rate of reading braille would have educational value by reducing the gap in rate of information intake between the sighted and the blind (Kederis, 1964, p. 1)."

The purpose of this study was to determine the effects of pacing and freehand methods of rapid reading instruction in braille on measures of reading rate and comprehension for blind students attending

residential and public schools in Weber County, Utah, during the 1975-1976 school year. An additional purpose was to determine the effect of rapid reading instruction on the hemispheric electroencephalogram patterns of these students.

Review of Literature

Early programs to educate blind children began in residential schools in Europe about 200 years ago. The first school of this type was established by Valentin Hauy in Paris, France in 1784 (French, 1932). In the United States residential schools started to enroll students in 1832. Day school programs for the educationally blind began in Chicago in 1900 (Hathaway, 1966). A history of special education reveals that children with visual disabilities were at first pitied and protected in special classes and schools and later accepted and integrated with sighted children into regular schools (French, 1932).

Hayes (1941) noted that visually impaired children have generally been shown to measure the same on achievement tests as seeing pupils in the same grade. However, he pointed out that the visually impaired child is at least two years older than seeing children in the same grade. Birch and others (1966), in a study of school achievement of partially sighted students in grades five and six, noted that these children were over age in grade placement by one year and nine months, and in addition, they were academically retarded by one year and eleven months. Lowenfeld and Abel (1967) investigated the reading rate and comprehension of 200 braille readers

from the fourth and eighth grades. The results were compared with measures of the same abilities in sighted readers.

> The data collected in connection with the testing part of the study indicate that blind fourth graders in local schools were 0.8 years and in residential school 1.2 years over-age; on the eighth grade level, the differences between blind and seeing students were only very small (Lowenfeld and Abel, 1967, p. 86).

Educational retardation for children with visual disabilities is due to a variety of causes. Among these are: (1) slower acquisition of information from observation as a result of the visual impairment; (2) slower reading rates; (3) lack of concreteness in instructional procedures; (4) loss of time in school due to surgery or treatment of eye conditions; (5) late provision of special education services. These factors point to the need for early identification of visually impaired children and the necessity to provide effective remedial education (Harley, 1963).

The system of raised-dot printing, which makes it possible for the blind to read using their sense of touch, was developed by Louis Braille in the nineteenth century. Other systems have been developed and tried, but the braille system became accepted throughout the world as the basis of reading codes for the blind (Goldish, 1967). Braille is composed of raised dots embossed into paper and read by passing the fingers lightly over the braille lines of the page. The braille cell consists of six dots in a two by three matrix. A combination of one or more dots can stand for letters, words, numbers or marks of punctuation. Grade 1 braille used a single cell for each character in English on a one-to-one correspondence. Grade 2 braille has a very complex grammar of 189 different characters and contractions (Ashcroft and Henderson, 1963).

Instruction in braille reading has received very limited coverage by researchers. There are just four books that have been written on the subject (Burklen, 1932; Maxfield, 1928; Lowenfeld et al., 1969; Nolan et al., 1969). Many journal articles and various papers have dealt with braille reading, but these are mainly interest articles and not studies. Burklen (1932) performed his research in Germany. He found that the whole word was the unit of perception in braille reading. Lowenfeld and Abel (1967), in their survey of reading instruction in braille, found that 64 percent of the teachers began teaching reading with whole words or meaningful sentences. "In general, it appears that most teachers of braille reading consider the whole word as the unit of recognition, and that the word is perceived on the basis of its over-all shape or form (Nolan and Kederis, 1969, p. 18)."

In a series of experiments from 1923 to 1950, Horbach(1951) concluded that there is an exact parallel between print and braille reading. His methods have been questioned and his results are not in agreement with Nolan (1966) who found that braille reading is not the whole word shape, but the individual braille reading character which is the perceptual unit in word recognition. Nolan and Kederis (1969) reported the results of seven studies which indicated that in braille the perceptual unit in word recognition is the braille cell. These studies have great implication for approaches designed to increase the reading rate of braille readers. In order to read faster, braille readers must learn to move their fingers rapidly from character to character.

> The evidence of all those who read successfully by the whole word or sentence method proves that the blind child proceeds so

> quickly from letter to letter in the movement of his reading finger(s) that the letters combine to a whole which, as such, becomes meaningful to him (Lowenfeld et al., 1969, p. 27).

There are numerous studies concerned with braille reading rates and attempts to increase the speed of reading braille. The average rate of touch reading is usually stated as two to three times slower than the average rate of print reading (Umsted, 1970). There is a wide range of ability and reading speed among braille readers. Meyers et al. (1958) tested 275 braille readers in grades five through twelve and reported an average reading rate of 68 words per minute (WPM). Foulke et al. (1962) found a mean braille reading rate of 64 WPM with 21 subjects in grades six through eight. Nolan (1966) studied braille reading rates of science and social studies materials for 246 students in grades four through twelve. Rates from 50 to 74 WPM were noted.

Henderson (1967) conducted a very significant study on training to increase braille reading speed. Her investigations centered on the conclusion that the braille character is the perceptual unit in braille reading. Twelve experimental subjects were matched with twelve control subjects from grades three through six. The pretest was given under a motivated condition for optimum performance. The experimental group was given braille character recognition training and the control group remained in their traditional reading programs. Posttest data revealed a statistically significant decrease in character recognition time and a significant increase in oral reading rate for the experimental group. The increase in silent reading rate and comprehension over the control group was not significant. Braille oral reading rates for the pretest averaged 73 WPM and for the posttest, 84 WPM.

Special equipment designed to help blind students increase their braille reading speeds has been used by several researchers. Barraga (1963) reported small positive results with training directed toward strengthening certain aspects of reading skills. Flanigan (1964) and Stockton (1965) used similar procedures in conducting studies with children and adults. Their subjects were paced in their reading performance by the rate of braille presentation on a continuous tape. Both reported significant reading rate increases. Kederis et al. (1967) paced the braille reading of students through tachistoscopic means and through the use of a variable-speed continuous belt display. No over-all significant increases of reading speed resulted. They did find that by manipulating motivational variables, reading speeds could be increased up to 100 percent without comprehension loss.

Conflicting research has been reported regarding which hand is the more efficient in reading braille. Burklen (1932) found that 50 out of 66 subjects read better with their left hands. Maxfield (1928) had previously noted that right-hand readers were more efficient than left-hand readers. They both agreed that the index finger of either hand was the best reading finger. Also they found that students who used both hands in maintaining their place and reading ahead with one hand while finishing a line with the other were superior to students who read with only one hand. Fertsch (1946) confirmed the advantage of using two hands in reading braille. She also found that for those reading with only one hand, the right hand-dominant individual performed better (Fertsch, 1947). Foulke (1964)

examined braille reading according to finger use. He found that the forefinger is the best reading finger and that the effectiveness of each finger decreases markedly as the little finger is approached. Previously Funchess (1934) had reported rapid improvement in reading ability with practice of normally unused fingers.

In addition to braille, the visually impaired use recorded material to supplement their braille reading. Talking Book records and tapes have become very popular with the blind. A comparison of the relative efficiency of comprehension by listening and tactual reading was made by Lowenfeld (1945). He found that on the sixth and seventh grade levels, there was no significant difference between the comprehension of braille and Talking Book reading for the more intelligent pupils. However, there was a significant difference in favor of braille reading for students of average and lower intelligence. Hampleman (1958) in a study involving sighted elementary school students, found listening comprehension showed a greater superiority over reading comprehension.

A natural outgrowth of recorded material was the possibility of speeding up the information presentation to that approaching the speed of reading print. Foulke, Amster, Nolan and Bixler (1962) conducted a study:

> . . . to measure comprehension by blind children as a function of word rate and of the kind of material heard, and to compare comprehension obtained at various word rates with that obtained when the same material was read in braille (p. 135).

Their experiment involved 291 braille readers in grades six through eight. Recorded matter was presented at rates of 175, 225, 275, 325, and 375 WPM. This technique has come to be known as

compressed speech. No significant loss in comprehension of literary material up through 225 WPM was found. At faster rates, the loss became significant. There was no significant loss in comprehension of scientific material through 275 WPM.

The electroencephalograph (EEG) has been used in some research studies with the visually handicapped to investigate the central nervous system. Adrian (1935) and Berger were the first persons to study EEGs of blind individuals. They found that the alpha rhythm was either missing or was poorly expressed in the visually handicapped. Subsequent investigations by others collaborated these findings. In 1936 Loomis, Harvey, and Hobart arrived at the conclusion that alpha rhythm disappeared in the blind because of the experimental conditions which evoked tension. Williams and Reynell, in work done in 1945, concluded that alpha rhythms develop independently from interruption of the visual pathway and are disturbed only by damage to the visual cortex. Finally Drever (1955) observed a poorer saliency and smaller amplitude of alpha rhythms among the blind in comparison with sighted people. He found that the mean amplitude for the blind was about twice as small as for the sighted.

Freeman and Thibos (1973) stated, "The absence of visual form during early stages of development of the nervous system has profound physiological, anatomical and behavioral consequences (p. 876)." Children blind from birth have EEG abnormalities generally confined to the occipital area of the brain (Yoshio et al., 1964). In a study of 111 learning disabled children with abnormal EEGs, Hartlage and Green (1973) tried to correlate intellective and academic performance with EEG patterns. No significant relationship was found. It was noted

that, "language functions are primarily subserved by the left hemisphere while nonlanguage cognitive functions are subserved by the right hemisphere (p. 42)." Isaacson, Douglas, Lubar and Schmaltz (1971) also confirmed that the left hemisphere is associated with speech and language. Sperry (1968) reported that the right hemisphere has the ability to organize material spatially and is responsible for nonverbal ideation. The right hemisphere has the possibility of being more efficient in analyzing information during rapid reading. According to Kimura (1973):

> . . . we can demonstrate left visual field (right hemisphere) superiority in spatial perception in spite of the fact that the subject ultimately gives a verbal response that is controlled from his left hemisphere. We explain this result by saying that the primary analysis is accomplished by the right hemisphere, and the verbal response is secondary (p. 75).

Additional evidence of the efficiency of the right hemisphere is provided by White (1969) who investigated the effects of rows of letters and digits presented across subjects' visual fields. Stimulus elements were better recalled when presented to the left visual field (right hemisphere) than when presented to the right visual field (left hemisphere). In cases where the brain has been surgically divided at the corpus callosum, Gazzaniga (1967) showed that the right hemisphere, when given the opportunity to express itself, prevailed over the left. This was demonstrated by flashing a word across the center of the visual field with half of it visible to each half of the brain and the patient pointing to the part of the word that he saw.

In summary very little information is available on the perceptual aspects of braille reading. "Research producing information of this type has, in most instances, been designed for other purposes

(Nolan and Dederis, 1969, p. 21)." In the area of teaching braille reading skills, almost no research can be found. Teachers of the blind apparently feel that the word is the basic unit on which reading is based. Research findings, however, stress the importance of the character of the individual braille cell in the recognition of words. Studies relating to the visually handicapped may be of limited value mainly due to three factors: (1) there is usually a small number of subjects involved, (2) blindness includes individuals who are partially sighted as well as the totally blind, and (3) the braille used may or may not be contracted (Lowenfeld et al., 1969). Compressed speech offers an alternative to braille reading by students to gain information. One immediate disadvantage to this media is the difficulty presented in locating an exact place on the tape or record containing specific information required by the reader. The EEG may help provide information concerning the hemispheric functions of the brain during the reading process.

Hypotheses

Four hypotheses were tested during the course of this investigation. The study tried to determine the effects of rapid reading instruction in braille on the reading rates, comprehension and EEG patterns of school age blind children.

1. There will be no significant difference in the mean gain of braille reading rates for blind students among the control, pacing or freehand treatment groups as measured by the Diagnostic Reading Test.

2. There will be no significant difference in the mean gain of braille reading comprehension for blind students among the control, pacing or freehand treatment groups as measured by the Diagnostic Reading Test.

3. There will be no significant difference in hemispheric dominance in electroencephalogram patterns for blind students among the control, pacing or freehand treatment groups as measured by an electroencephalograph.

4. There will be no significant interaction among methods of instruction, intelligence quotient (IQ), and sex for those blind students participating in the study.

Delimitations

This study was limited to the analysis of braille reading rate and comprehension for two experimental groups and one control group of legally blind students after different types of rapid reading instruction as measured by the Diagnostic Reading Test. Only visually handicapped, braille reading students enrolled in grades five through twelve during the 1975-1976 school year and residing in Weber County, Utah, participated. Just the alpha and beta brain waves for both hemispheres of each student were considered in measuring the patterns produced by the electroencephalograph.

Definitions

Alpha rhythm. An eight to thirteen cycles per second rhythm often seen in the EEG of a resting but awake subject.

Beta rhythm. A fourteen to thirty cycles per second brain wave pattern seen in the EEG and associated with anxiety or tension.

Desynchronization. Low-voltage, fast electrical activity in the brain due to a novel stimulus.

Electroencephalogram (EEG). The recording of the electrical activity of the brain taken from electrodes placed on the scalp.

Freehand. A method of rapid reading instruction using verbalized directions to encourage subjects to cover more tactual information in shorter periods of time.

Hemispheric dominance. When the electrical activity of the brain is more clearly evident in one half of the cerebrum as compared to the other.

Pacing. A method of rapid reading instruction utilizing sequentially speeded speech compression with subjects simultaneously reading the material in braille.

Speech compression. A speeding up of recorded material to decrease the listening time.

Synchronization. High-voltage, slow electrical activity in the brain associated with sleep.

Chapter 2

METHODS

Subjects

The subjects for this study were braille readers enrolled in grades five through twelve in Weber County, Utah. Each participant was legally blind and a student in either public school or the state residential school for the blind. Every subject had used braille as his or her primary reading media for at least one year. Those participating were randomly assigned to one of three groups. The population of braille reading students was limited, but by using an age range from 10 to 21, 24 subjects were chosen. Table 1 shows a distribution of subjects by treatment groups. Names were obtained from the files of the Utah School for the Blind located in Ogden, Utah. The population for this study was all braille reading, legally blind students attending Utah public schools or the Utah School for the Blind from the fifth through the twelth grades. It was estimated that 80 students would fall into this category during the 1975-1976 school year.

Instruments

The Slosson Intelligence Test (SIT) was administered to all subjects to determine their intelligence quotient (IQ) for assignment purposes. The SIT correlates very highly with results of the Stanford-Binet and the Wechsler Intelligence Scale for Children (WISC) (Slosson,

Table 1

Distribution of Subjects

IQ	Sex	Treatments		
		Control	Pacing	Freehand
High	Male	2	2	2
High	Female	2	2	2
Low	Male	2	2	2
Low	Female	2	2	2
	Total	8	8	8

Total Subjects = 24

1971). When testing the blind with the SIT, only minor adjustment in a very few items is required as it is a verbal test. A reliability coefficient of .97 was obtained for the SIT with a test-retest interval of two months with 139 individuals from four to 50 years of age. IQ correlations with the Stanford-Binet averaged .95 for 701 individuals ranging in ages from four to 18 and up. A relationship in full scale IQ scores between the WISC and the SIT revealed an average difference of 7.7 on a sample of children aged six to 16. Hammill, Crandell and Colarusso (1970) stated that this short intelligence test (SIT) yields sufficiently valid IQs to be useful as a screening instrument. No significant sex differences were found for any age group.

The upper and lower levels of the survey section of the Diagnostic Reading Test (Committee on Diagnostic Reading Tests, 1952) was used to determine reading rate and paragraph comprehension for those participating in the study. Form A was used as the pretest and Form B as the posttest. These tests were obtained in print from the publisher and transcribed into braille. The test-retest reliability for the Diagnostic Reading Test (DRT) based on a population of 100 blind students in grades seven through twelve was .80 for reading rate and .83 for paragraph comprehension. The validity was calculated using Flanagan's table for estimating biserial correlation. Content validity for reading rate using the DRT was .47 for Form A and .59 for Form B. Content validity for paragraph comprehension was .48 for Form A and .44 for Form B.

Procedures

Twenty-four blind students enrolled in school in Weber County, Utah, were given the SIT and assigned at random by sex and IQ to two experimental groups and a control group using a table of random numbers. An EEG for each subject was recorded on a Grass Model 6 Electroencephalograph at the Utah State Training School, American Fork, Utah. The first few minutes of the EEG was recorded with the students in a resting state. The electrical patterns exhibited synchronization and much alpha rhythm. Then the students were asked to read braille for four minutes at their normal rate, which produced desynchronization and much beta rhythm. All groups were pretested for reading rate and comprehension using Form A of the DRT. Secondary students were given both the upper and lower level sections of the DRT for the pretest. If comprehension was below 50 percent on the upper level test, then the lower level results were used. The lower level test was administered as the posttest for students in this situation. The reading rate in words per minute was computed by dividing the number of words read by the number of minutes taken to read the selection. A comprehension percentage score was calculated based on the number of questions answered correctly after reading the selection.

One experimental group was then taught rapid reading of braille using the freehand method of instruction and a second group was taught using the pacing method. The third group acted as a control and received no instruction. Specific daily lesson plans were followed for a five week period in an attempt to increase the braille

reading rate and comprehension of the treatment groups. McBride (1974) and Wallace (1973) gave detailed directions for rapid reading instruction which have proven successful for both the blind and the partially sighted. Their techniques were followed in the freehand instruction group. The pacing group listened to recorded material on tape while simultaneously reading identical material in braille. The recording was speeded up at intervals with the blind subjects keeping pace. Appendix B contains lesson plans for the pacing method of instruction and Appendix C details lesson plans for the freehand method.

The Hawthorne effect was taken into consideration during this study, but certain factors helped to minimize this phenomenon. Visually handicapped students have often been involved with new approaches and programs and have become accustomed to special treatment situations. During daily lessons the purpose of the reading program was stressed, which was to benefit the individual student. The incentive, therefore, was to improve performance for personal gain. No mention was made of the possibility of generalizing the findings to other blind students. The use of a control group gave a basis for judging the seriousness of the Hawthorne effect by comparing mean pretest, posttest and gain scores of the control group. A small gain in reading rate by the control group could reasonably be expected as normal growth over the period of time covered by the study. A Significant increase would indicate the possible presence of the Hawthorne effect.

At the completion of the treatment period, all groups were posttested for reading rate and comprehension on Form B of the DRT. Individual EEG patterns were again recorded while subjects read as rapidly as possible. Coefficients involving frequency and amplitude of brain wave patterns were used to compare prior EEGs and those taken at the conclusion of training. Figures for EEG patterns used in the statistical analyses were an average of the coefficients of information transmission for the left hemisphere minus the coefficients for the right hemisphere (Calloway and Harris, 1974). Brain wave patterns were analyzed to determine if a shift in hemispheric dominance from left to right had taken place after rapid reading instruction. In the event a shift occurred it would be an indication that speed reading involved a different integration process and cortical location than normal reading.

Analyses

The method of research employed in the study was experimental. All relevant variables could not be controlled since there were few blind subjects available and randomization was limited. A pretest-posttest control group design was the basis for this study. An analysis of covariance with pretest scores as the co-variate was performed to determine if the null hypotheses could be rejected and to find significant differences. The dependent variables were tested for their effect on the subjects according to the statistical model. To be considered significant, all tests had to reach at least the .10 level of confidence.

The model used for statistical analysis was:

$Y_{ijkl} = \mu + T_i + I_j + TI_{ij} + S_k + TS_{ik} + IS_{jk} + TIS_{ijk} + E_{(ijk)l}$

Y_{ijkl} = Dependent variables. The mean gain scores for braille reading rate, braille comprehension, and change in EEG patterns.

μ = The overall mean.

T_i = Treatments.

$i = 1$ Control

$i = 2$ Pacing method of instruction

$i = 3$ Freehand method of instruction

I_j = Individual IQ.

$j = 1$ Low

$j = 2$ High

TI_{ij} = Interaction between treatment and IQ.

S_k = Sex.

$k = 1$ Male

$k = 2$ Female

TS_{ik} = Interaction between treatment and sex.

IS_{jk} = Interaction between IQ and sex.

TIS_{ijk} = Interaction among treatment, IQ and sex.

$E_{(ijk)l}$ = Experimental error.

Chapter 3

RESULTS

Reading Rates

The findings regarding the present study are arranged in the same order as the hypotheses were presented. Table 2 provides data for an analysis of variance conducted on the rate scores of the braille reading pretest. IQ was a significant factor, as those students with an IQ above 100 read significantly faster than those with an IQ lower than 100. Table 3 is an analysis of variance of the braille reading rate posttest scores. Again there appeared a significant difference between students with a high and low IQ. Those students with an IQ over 100 read faster than those with an IQ below 100.

An analysis of covariance was performed on the braille reading rate gain between the pretest and posttest scores (Table 4) with the pretest scores as the covariate. The pacing group increased 23.77 WPM while the freehand group increased 23.42 WPM. These increases in braille reading rates were significantly greater than the increase in rate for the control group which was 2.71 WPM at the .006 level of confidence. There was no significant difference between the pacing and freehand methods of instruction. Table 23, Appendix E, lists the means and cell sizes associated with the data analyzed for braille reading rates. The pretest means in WPM for the three treatment

Table 2

Analysis of Variance for Pretest Reading Rates

Source	df	MS	F	P
Treatment	2	511.07	.622	NS
Con vs Pace & Free	1	254.84	.310	NS
Pacing vs Freehand	1	767.29	.934	NS
IQ	1	9204.20	11.208	.007
Treatment x IQ	2	365.51	.445	NS
C vs P & F x IQ	1	47.20	.057	NS
P vs F x IQ	1	683.82	.833	NS
Sex	1	2005.70	2.442	NS
Treatment x Sex	2	922.42	1.123	NS
C vs P & F x Sex	1	1640.30	1.997	NS
P vs F x Sex	1	204.49	.249	NS
IQ x Sex	1	1497.80	1.824	NS
Treatment x IQ x Sex	2	1706.10	2.078	NS
C vs P & F x IQ x Sex	1	2664.10	3.244	.10
P vs F x IQ x Sex	1	748.02	.911	NS
Error	12	821.18		

Table 3

Analysis of Variance for Posttest Reading Rates

Source	df	MS	F	P
Treatment	2	844.37	.618	NS
Con vs Pace & Free	1	1039.70	.761	NS
Pacing vs Freehand	1	729.00	.534	NS
IQ	1	12545.00	9.183	.011
Treatment x IQ	2	939.65	.688	NS
C vs P & F x IQ	1	939.87	.688	NS
P vs F x IQ	1	939.42	.688	NS
Sex	1	2511.30	1.838	NS
Treatment x Sex	2	1065.50	.780	NS
C vs P & F x Sex	1	2112.10	1.546	NS
P vs F x Sex	1	18.92	.014	NS
IQ x Sex	1	1228.40	.899	NS
Treatment x IQ x Sex	2	2083.60	1.525	NS
C vs P & F x IQ x Sex	1	3798.50	2.781	NS
P vs F x IQ x Sex	1	368.64	.270	NS
Error	12	1366.10		

Table 4

Analysis of Covariance for Gain in Reading Rates

Source	df	MS	F	P
Pretest	1	373.73	1.767	NS
Treatment	2	1274.90	6.026	.02
Con vs Pace & Free	1	2567.10	12.135	.006
Pacing vs Freehand	1	34.46	.163	NS
IQ	1	3.55	.017	NS
Treatment x IQ	2	262.07	1.239	NS
C vs P & F x IQ	1	501.55	2.371	NS
P vs F x IQ	1	.33	.002	NS
Sex	1	9.57	.045	NS
Treatment x Sex	2	70.53	.352	NS
C vs P & F x Sex	1	5.07	.024	NS
P vs F x Sex	1	158.88	.751	NS
IQ x Sex	1	108.71	.514	NS
Treatment x IQ x Sex	2	85.64	.405	NS
C vs P & F x IQ x Sex	1	.001	.000	NS
P vs F x IQ x Sex	1	168.80	.798	NS
Error	11	211.55		

groups were 56.15 for the control, 42.31 for pacing and 56.16 for the freehand. The posttest means in WPM for the three groups were 58.86 for the control, 66.08 for pacing and 79.58 for freehand. The percent increases between pretest and posttest scores were 4.8 for the control group, 56.2 for the pacing group and 41.7 for the freehand group.

Figure 1 is a graphic illustration showing interaction between the means of the treatment groups by IQ and sex. Although this interaction was significant at only the .10 level of confidence, it indicates a wide variation of mean scores by sex on the pretest of braille reading rates for students with a high IQ. The same interaction between treatment, IQ and sex was plotted in Figure 2 for mean scores on the reading rate posttest. This interaction, while not being significant, shows the same pattern as Figure 1. Another interaction developed between the treatment groups and IQ for mean gains in braille reading rates (Figure 3). The high IQ students in the control group actually decreased in reading rate between pre and posttests, while all other groups reflected an increase. Those students with a high IQ in the treatment groups gained an average of 13.4 WPM more than those with a low IQ. However, the percent increase in reading rate between pre and posttests was greater for those students in the treatment groups having a low IQ.

Comprehension

There was no significant differences noted for comprehension between the pretest and posttest means for the control and the two experimental groups. Table 5 contains the results of an analysis of variance for pretest comprehension and Table 6 shows the same

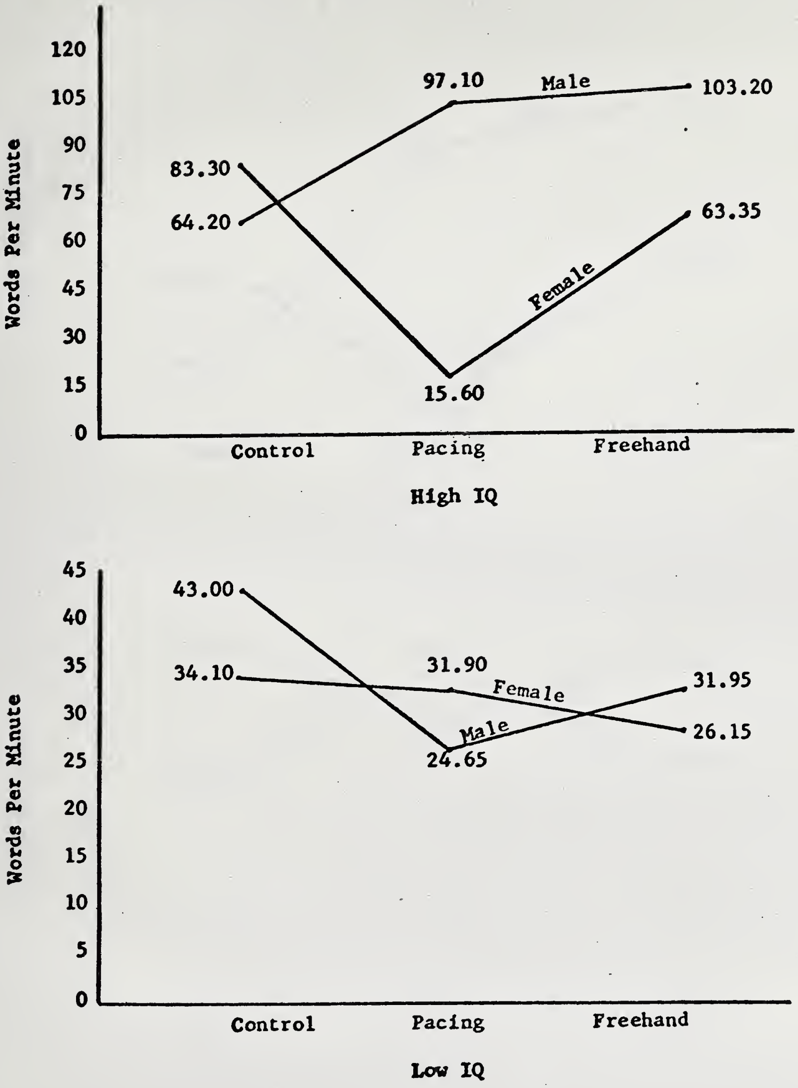
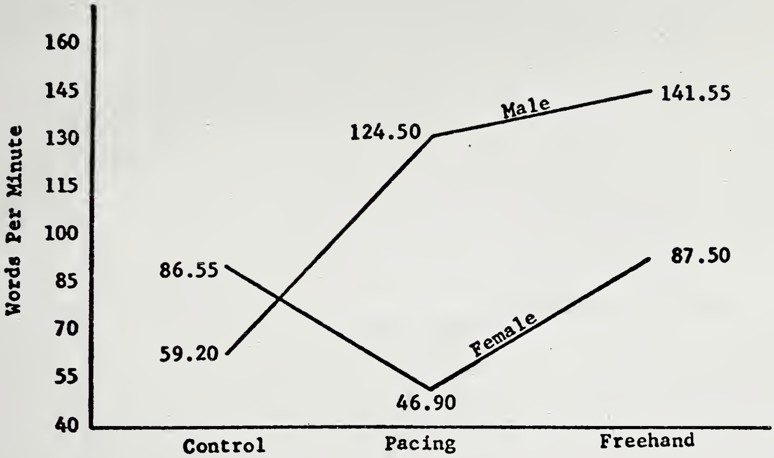
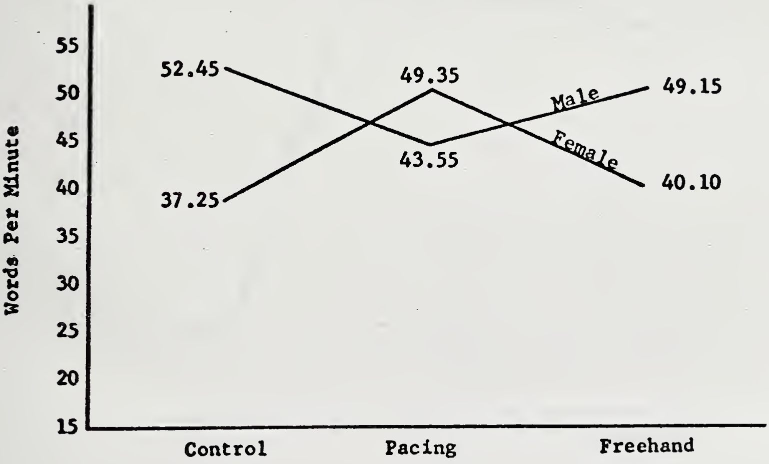


Figure 1

Interaction Among Treatment, IQ and
Sex for Pretest Reading Rates



High IQ



Low IQ

Figure 2

Interaction Among Treatment, IQ and Sex for Posttest Reading Rates

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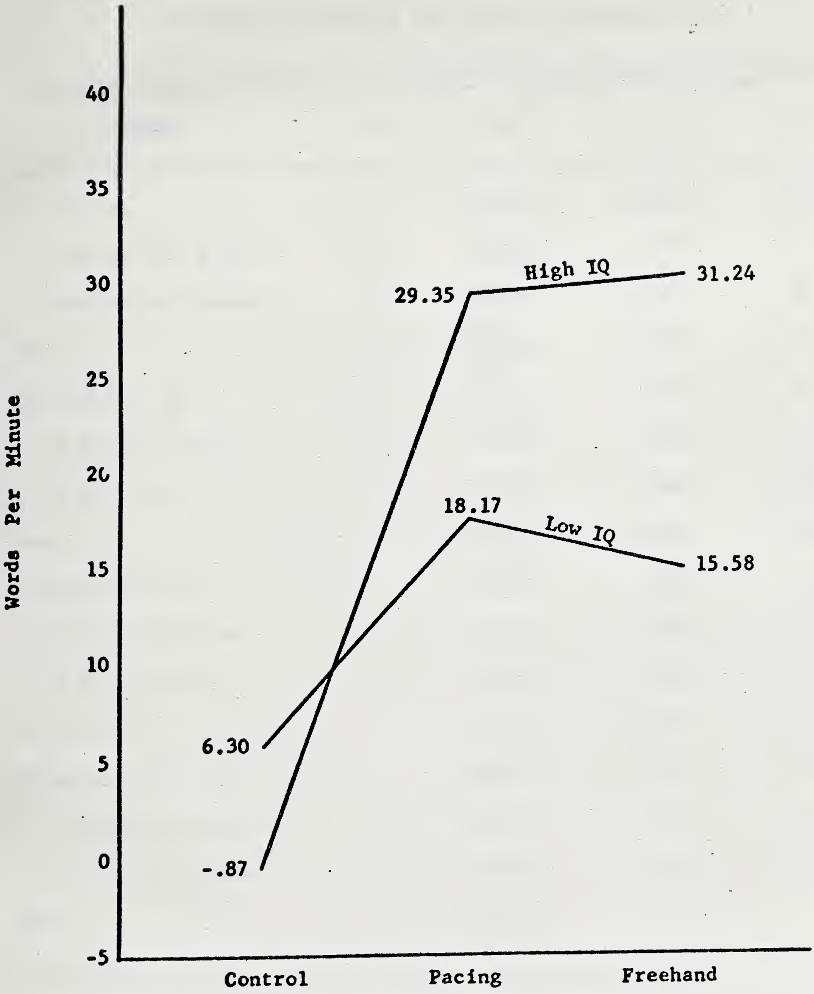

Figure 3

Interaction Between Treatment and IQ
for Gains in Reading Rates

Table 5

Analysis of Variance for Pretest Comprehension

Source	df	MS	F	P
Treatment	2	822.17	1.591	NS
Con vs Pace & Free	1	320.33	.577	NS
Pacing vs Freehand	1	1444.00	2.604	NS
IQ	1	1365.00	2.462	NS
Treatment x IQ	2	50.17	.090	NS
C vs P & F x IQ	1	44.08	.080	NS
P vs F x IQ	1	56.25	.101	NS
Sex	1	477.04	.860	NS
Treatment x Sex	2	420.17	.758	NS
C vs P & F x Sex	1	420.08	.758	NS
P vs F x Sex	1	420.25	.758	NS
IQ x Sex	1	1107.00	2.000	NS
Treatment x IQ x Sex	2	288.67	.521	NS
C vs P & F x IQ x Sex	1	456.33	.823	NS
P vs F x IQ x Sex	1	121.00	.218	NS
Error	12	554.46		

Table 6

Analysis of Variance for Posttest Comprehension

Source	df	MS	F	P
Treatment	2	99.29	.264	NS
Con vs Pace & Free	1	16.33	.043	NS
Pacing vs Freehand	1	182.25	.484	NS
IQ	1	337.50	.896	NS
Treatment x IQ	2	81.38	.216	NS
C vs P & F x IQ	1	18.75	.050	NS
P vs F x IQ	1	144.00	.382	NS
Sex	1	1504.20	3.993	.075
Treatment x Sex	2	271.54	.721	NS
C vs P & F x Sex	1	374.08	.993	NS
P vs F x Sex	1	169.00	.449	NS
IQ x Sex	1	2.67	.007	NS
Treatment x IQ x Sex	2	208.29	.553	NS
C vs P & F x IQ x Sex	1	176.33	.468	NS
P vs F x IQ x Sex	1	240.25	.638	NS
Error	12	376.67		

Table 7

Analysis of Covariance for Gain in Comprehension

Source	df	MS	F	P
Pretest	1	906.58	5.327	.045
Treatment	2	70.14	.042	NS
Con vs Pace & Free	1	50.15	.295	NS
Pacing vs Freehand	1	90.13	.530	NS
IQ	1	20.23	.119	NS
Treatment x IQ	2	26.20	.154	NS
C vs P & F x IQ	1	.02	.0001	NS
P vs F x IQ	1	52.39	.308	NS
Sex	1	583.40	3.428	.095
Treatment x Sex	2	19.33	.114	NS
C vs P & F x Sex	1	38.66	.227	NS
P vs F x Sex	1	.004	.000	NS
IQ x Sex	1	321.26	1.888	NS
Treatment x IQ x Sex	2	36.10	.212	NS
C vs P & F x IQ x Sex	1	.04	.0002	NS
P vs F x IQ x Sex	1	71.97	.423	NS
Error	11	170.17		

information for posttest comprehension of braille material. A significant difference did exist, at the .075 level of confidence, between sexes for the means of the comprehension posttest. The male students scored significantly lower than the females on the posttest for comprehension. This situation is again apparent in the analysis of covariance for gain in comprehension shown in Table 7. The males decreased 4.1 percent in comprehension between the pre and posttests, while the females increased 6.0 percent. No other factors approached significance in the analyses pertaining to comprehension. Table 24, Appendix E, lists the means and cell sizes associated with the data analyzed for the comprehension of braille reading.

Electroencephalogram Patterns

The EEG patterns were analyzed using the same statistical model as that used for reading rates and comprehension. Table 8 details an analysis of variance for pretest EEG patterns. There was no difference between the patterns of treatment groups. Significant interaction was noted between treatment and IQ and between IQ and sex. Figures 4 and 5 detail this interaction. Students in the control group with low IQ showed much greater EEG activity than students with a high IQ (Figure 4). Interaction between IQ and sex was very apparent in Figure 5 for pretest EEG patterns. Males with low IQ showed less activity than males with high IQ. Just the reverse was noted for females. Those with low IQ showed more activity than those females with high IQ.

An analysis of variance for EEG posttest patterns is shown in Table 9. The patterns of the treatment groups reflected no

Table 8

Analysis of Variance for Pretest EEG Patterns

Source	df	MS	F	P
Treatment	2	.219	.061	NS
Con vs Pace & Free	1	.047	.013	NS
Pacing vs Freehand	1	.391	.109	NS
IQ	1	3.190	.892	NS
Treatment x IQ	2	11.198	3.131	.085
C vs P & F x IQ	1	22.005	6.154	.035
P vs F x IQ	1	.3906	.109	NS
Sex	1	.1276	.036	NS
Treatment x Sex	2	.667	.186	NS
C vs F & P x Sex	1	.333	.093	NS
P vs F x Sex	1	1.000	.280	NS
IQ x Sex	1	16.253	4.546	.06
Treatment x IQ x Sex	2	2.260	.632	NS
C vs F & P x IQ x Sex	1	.521	.146	NS
P vs F x IQ x Sex	1	4.000	1.119	NS
Error	12	3.576		

Table 9

Analysis of Variance for Posttest EEG Patterns

Source	df	MS	F	P
Treatment	2	.008	.008	NS
Con vs Pace & Free	1	.012	.013	NS
Pacing vs Freehand	1	.004	.004	NS
IQ	1	3.375	3.620	.09
Treatment x IQ	2	5.023	5.388	.025
C vs P & F x IQ	1	9.856	10.572	.008
P vs F x IQ	1	.191	.205	NS
Sex	1	.667	.715	NS
Treatment x Sex	2	2.206	2.366	NS
C vs P & F x Sex	1	.158	.169	NS
P vs F x Sex	1	4.254	4.563	.06
IQ x Sex	1	.042	.045	NS
Treatment x IQ x Sex	2	1.440	1.545	NS
C vs P & F x IQ x Sex	1	.033	.035	NS
P vs F x IQ x Sex	1	2.848	3.055	NS
Error	12	.932		

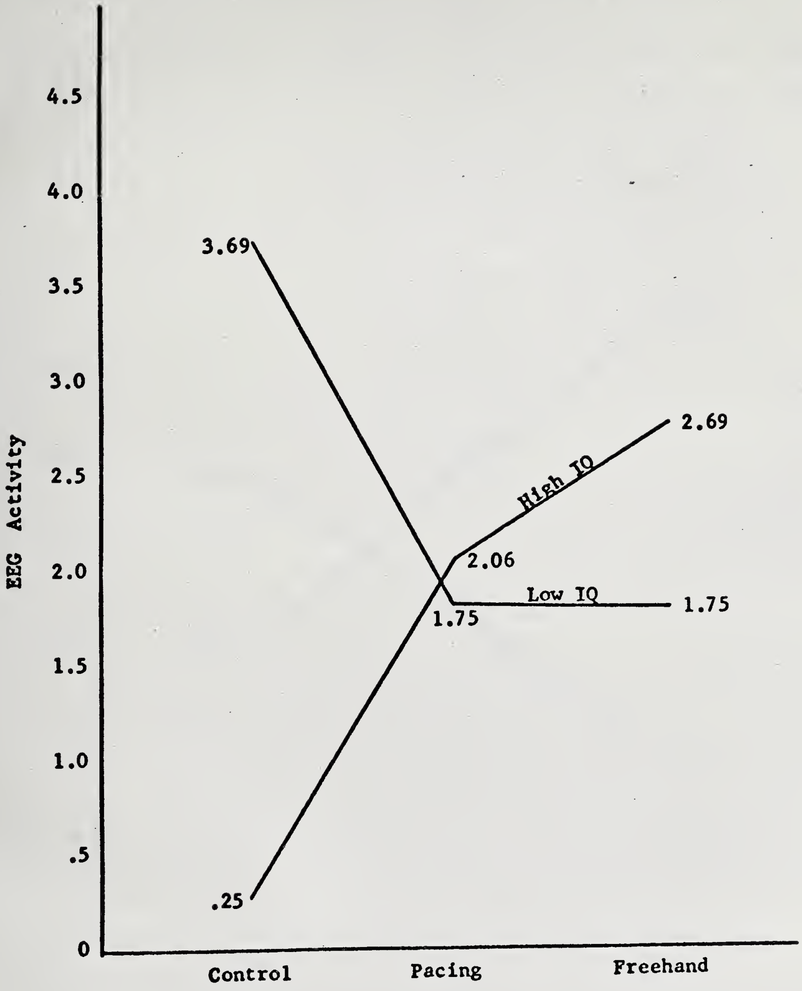

Figure 4

Interaction Between Treatment and IQ
for Pretest EEG Patterns

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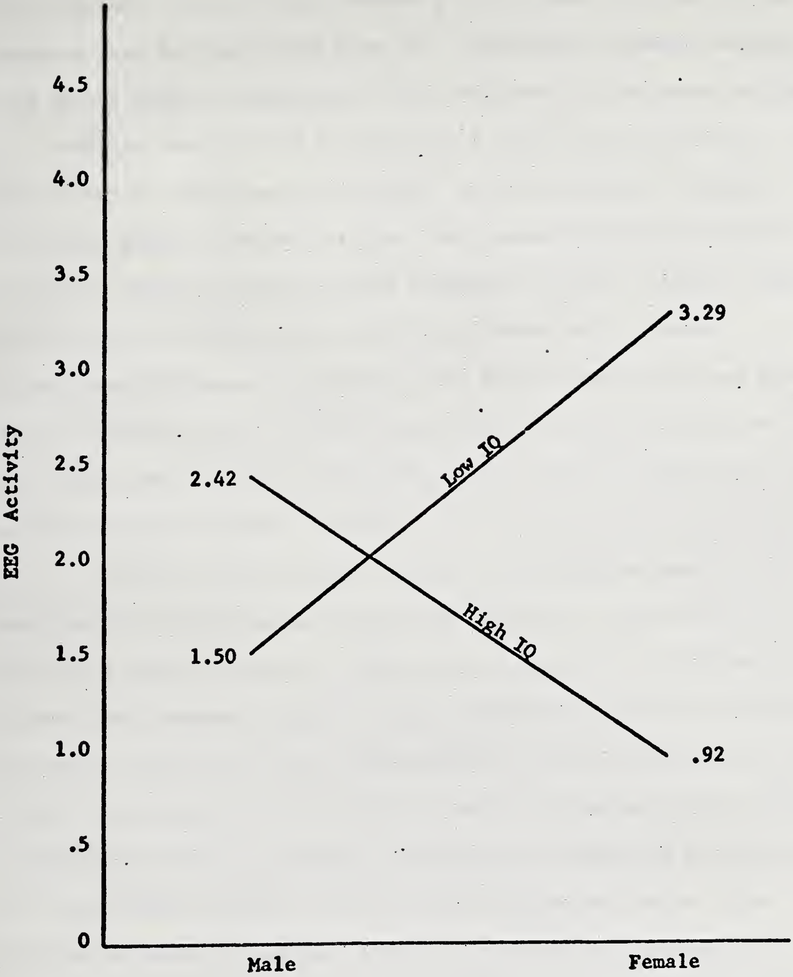

Figure 5

Interaction Between IQ and Sex for Pretest EEG Patterns

significant differences. IQ was slightly significant at the .09 level of confidence, since the EEG activity for students with low IQ was greater than for those with high IQ. Interaction between treatment and IQ was highly significant at the .008 level as evidenced by Figure 6. Students with high IQ in the control group had significantly less EEG activity than those with low IQ. In the pacing and freehand treatment groups, the EEG activity for low and high IQ students was similar. Further interaction was graphed in Figure 7 between treatment and sex for EEG posttest activity. There was a somewhat significant difference at the .06 level between the pacing and freehand treatment groups by sex. The male EEG activity was greater than the female EEG activity in the pacing group, but the reverse was true in the freehand treatment group.

The EEG pattern changes between pretesting and posttesting were analyzed utilizing an analysis of covariance, the results of which are shown in Table 10. There was no significant differences between the treatment groups. Again significant interaction existed between treatment and IQ for EEG patterns at the .025 confidence level. Figure 8 portrays this interaction in which the control group differs significantly from the changes in EEG patterns exhibited by the other two experimental groups, with IQ as the influencing factor. The interaction between treatment and sex for EEG pattern changes was significant at the .075 level and was plotted in Figure 9. The females in the pacing group showed a greater change in EEG patterns between the pre and the posttests than the male students. Results were just the opposite for the freehand group. Table 25, Appendix E,

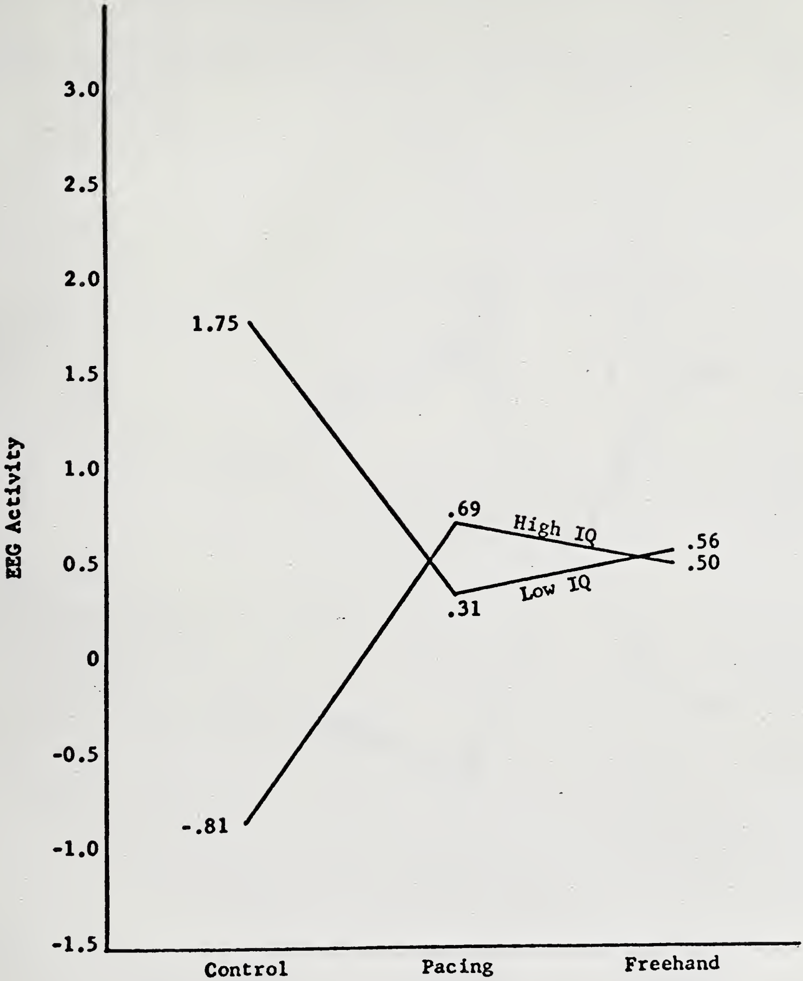

Figure 6

Interaction Between Treatment and IQ
for Posttest EEG Patterns

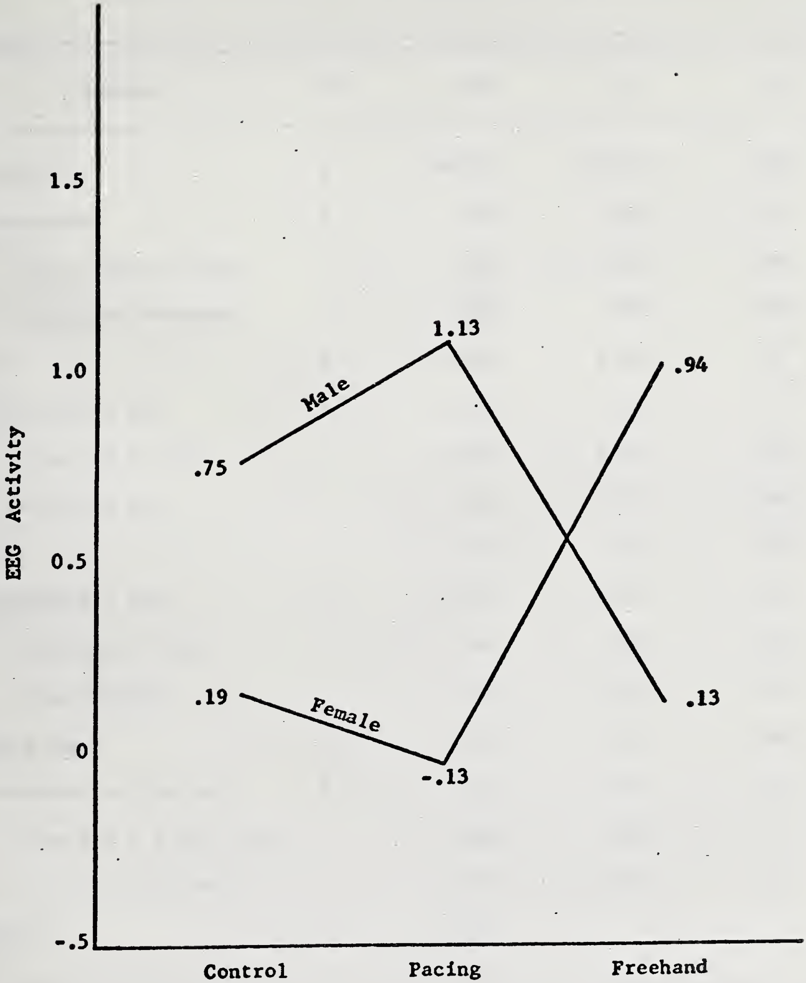

Figure 7

Interaction Between Treatment and Sex
for Posttest EEG Patterns

Table 10

Analysis of Covariance for Change in EEG Patterns

Source	df	MS	F	P
Pretest	1	44.356	43.659	.001
Treatment	2	.009	.009	NS
Con vs Pace & Free	1	.013	.012	NS
Pacing vs Freehand	1	.005	.005	NS
IQ	1	3.245	3.194	NS
Treatment x IQ	2	3.513	3.458	.07
C vs P & F x IQ	1	6.845	6.737	.025
P vs F x IQ	1	.181	.178	NS
Sex	1	.655	.645	NS
Treatment x Sex	2	2.127	2.094	NS
C vs P & F x Sex	1	.164	.161	NS
P vs F x Sex	1	4.090	4.026	.075
IQ x Sex	1	.014	.013	NS
Treatment x IQ x Sex	2	1.258	1.238	NS
C vs P & F x IQ x Sex	1	.028	.028	NS
P vs F x IQ x Sex	1	2.502	2.463	NS
Error	11	1.016		

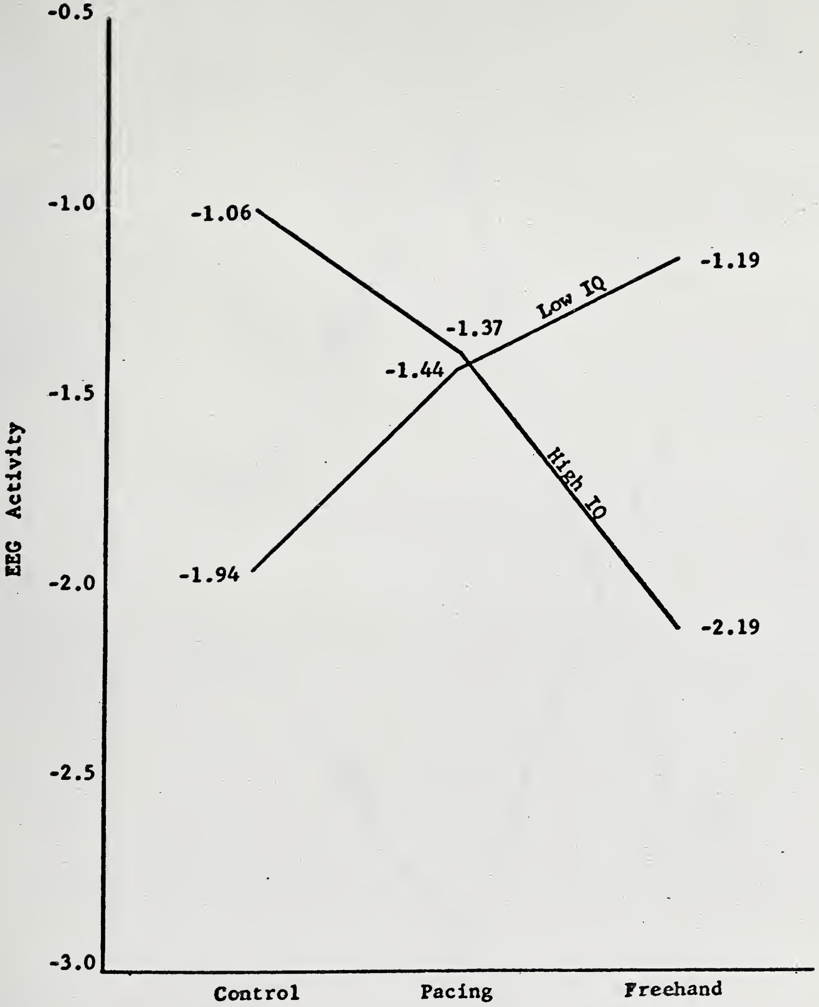

Figure 8

Interaction Between Treatment and IQ
for EEG Pattern Change

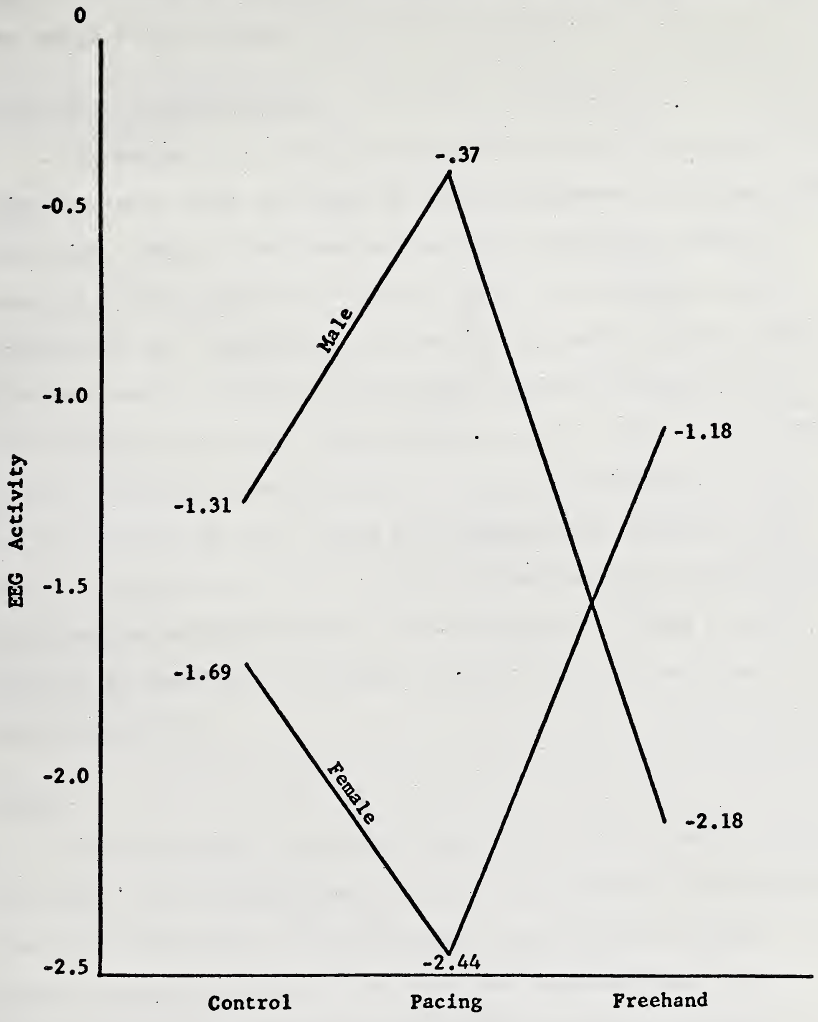

Figure 9

Interaction Between Treatment and Sex
for EEG Pattern Change

lists the means and cell sizes associated with the data analyzed for the change in EEG patterns.

Intelligence Quotient Scores

An analysis of variance was performed on the IQ scores for the three treatment groups following the random assignment of subjects for this study. Table 11 indicates no significant difference among IQ means of the three experimental groups for either treatment, sex, or treatment by sex. Apparently the selection of students using a table of random numbers resulted in a successful random assignment of students by IQ and sex to the three treatment groups. Table 26, Appendix E, lists the means of the IQ scores for the three treatments, for sex and for treatment by sex. A test for homogeneity of slopes was conducted in conjunction with the analysis of covariance for reading rate, comprehension and EEG patterns. This is reflected in Table 12 which indicates no significant differences for the slopes of the three dependent variables.

Summary

Four hypotheses were tested during this study of rapid reading in braille. The null hypothesis for rates was rejected as there was a significant difference in braille reading rates of blind students between the control group and the pacing and freehand groups. The null hypothesis for comprehension of braille material by students within the three treatment groups was not rejected. There was no significant gain or loss of comprehension between the control group and the pacing and freehand groups.

Table 11

Analysis of Variance for IQ Scores

Source	df	MS	F	P
Treatment	2	8.042	.014	NS
Con vs Pace & Free	1	13.021	.022	NS
Pacing vs Freehand	1	3.063	.005	NS
Sex	1	345.040	.592	NS
Treatment x Sex	2	4.542	.008	NS
C vs P & F x Sex	1	7.521	.013	NS
P vs F x Sex	1	1.563	.003	NS
Error	18	582.76		

Table 12

Tests for Homogeneity of Slopes

Source	df	MS	F	P
Rate				
Slopes	7	1291.9	1.19	NS
Error	4	1082.3		
Comprehension				
Slopes	7	140.42	.632	NS
Error	4	222.25		
EEG Patterns				
Slopes	7	.8951	.730	NS
Error	4	1.2270		

There was insufficient evidence by which to reject the null hypothesis for differences in hemispheric dominance in the EEG patterns for students in the three treatment groups. There was no significant change in EEG patterns for blind students in the control, pacing or freehand groups following rapid reading instruction in braille. Interaction was noted between the independent variables in the analysis of reading rate and EEG patterns, but not in comprehension. Figures 1 through 9 graphically portray any interaction that appeared significant, therefore, the null hypothesis for interaction was partially rejected in these instances.

Chapter 4

DISCUSSION

Review of Results

This study investigated the effect of rapid reading instruction on the braille reading rates, comprehension and EEG patterns of blind students. The control and freehand treatment groups had nearly identical reading rates on the pretest. The control group averaged 56.15 WPM, while the freehand group had a mean of 56.16 WPM. The pacing group was somewhat lower with an average of 42.31 WPM, although the difference from the other two groups was not statistically significant.

The reading rate gain for the pacing and freehand groups was almost the same. The pacing group increased by 23.77 WPM between the pre and posttests, and the freehand group reflected a gain of 23.42 WPM between the same tests. Since the pacing group had a lower pretest mean than the freehand group, the percentage gain was higher. The pacing group increased 56.2 percent in reading rate while the freehand group gained 41.7 percent. Further studies are needed to determine if the pacing method of rapid reading instruction in braille is superior to the freehand method as indicated by the present study.

The freehand method of rapid reading instruction in braille is similar to the technique developed by McBride (1974) and subsequently utilized by Wallace (1973), Crandell and Wallace (1974), and

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Olson, Harlow and Williams (1975). McBride (1974) reported an average braille reading rate gain of 572 WPM for subjects who were mostly adults using informal testing procedures. Wallace (1973) used a formal testing situation for subjects 16 to 50 years old, who achieved a mean gain of 30.9 WPM in reading braille. Crandell and Wallace (1974) reported an average gain of 61.6 WPM with subjects ranging from 16 to 50 years of age using formal tests. Olson, Harlow and Williams (1975) in replicating McBride's methods on subjects 10 to 65 years old reported an average gain of 34.5 WPM with formal tests. Hodson, Hoeksema and Weiner (1975) explored the effectiveness of braille speed reading techniques with blind adults and reported a mean gain of 37 WPM using formal tests.

The present study did not achieve as high a gain in the average words per minute read as previous studies, however the 14.6 mean age for subjects, which ranged from 10 to 21 years, was considerably lower. The percentage increase in reading rate for the pacing and freehand groups combined was 48.9. This figure was higher than the Olson, Harlow and Williams study (40.1 percent) and the Hodson, Hocksema and Weiner study (46.3 percent). It was also higher than the Wallace study which showed a 38.9 percent gain in average reading rate.

No research was available regarding the pacing method of rapid reading instruction in braille, therefore no comparisons were possible. This is an avenue that holds considerable promise for future research. The pacing technique uses two sensory modalities for assimilating data from the enviornment; aural and tactual. It offers

immediate feedback for the reader when an unfamiliar word is encountered. The low IQ group made a greater percentage increase in WPM read than the high IQ group while engaged in the pacing method of instruction. This technique could be a valuable teaching tool with young braille readers of low ability.

Further research is needed to determine if the effects of pacing and freehand instruction in braille rapid reading is lasting. Maxwell and Mueller (1967) suspect that college students can increase their reading rate 40 percent by suggestion and encouragement. This raises the question whether motivation, or training and practice was responsible for the braille reading rate gain in this study. Follow up and longitudinal studies involving blind students utilizing various methods for increasing braille reading rates both with and without the motivation factor would be valuable.

The control and pacing treatment groups showed a slight, but nonsignificant gain in comprehension between the pre and posttests. Students in the control group gained 4.87 percentage points while those in the pacing group increased 5.0 percentage points. Pupils in the freehand group decreased 7.25 percentage points. The analysis of covariance for comprehension gain revealed a small difference between the sexes. The females increased 4.33 percentage points, while the males decreased 2.58 percentage points. This difference is not great enough to suggest that females benefited more than males from participating in the rapid reading program and is considered the result of a limited sampling of subjects. In confirming the hypotheses for no difference in braille reading comprehension prior to and following

rapid reading instruction, it was demonstrated that there was no significant loss in comprehension as the reading rates increased for students in this study.

Kederis, Nolan and Morris (1967) stated that braille reading speeds could be increased up to 100 percent with no loss in comprehension. Other studies conducted to increase the rate of reading braille; Wallace (1973), Crandell and Wallace (1974), Olson, Harlow, and Williams (1975), and Schale (1975), all reported no significant gain or loss in comprehension. There is some evidence, Tremonti (1964), that comprehension can increase significantly following instruction in speed reading of print materials by the sighted using a variety of techniques and materials. Neither this study nor the other studies previously referenced reflected a significant increase in the comprehension of braille material. The nature of braille reading with the single braille cell as the perceptual unit in word recognition, as confirmed by Nolan and Kederis (1969), appears to held comprehension relatively constant over a wide range of reading rates.

The purpose of analyzing EEG patterns prior to and subsequent to rapid reading instruction was to detect any shift in hemespheric dominance following the training period. No change was apparent among the treatment groups as shown by the analysis of data for EEG patterns. There were indications of a possible shift for two individuals in the pacing group. It is probable that reading rates attained by students in this study were insufficient to facilitate a change in the portion of the brain that handled the reading function. By using a computer in conjunction with the EEG machine, a more accurate record of

information transmission within the brain could be assembled. A shift in hemespheric dominance could then be measured precisely.

The significant interactions noted for pretest, posttest and changes in EEG patterns for treatment by IQ were likely due to the nature of the task performed by the subjects in this study. Rapid reading requires intense concentration which produces a low-voltage, fast EEG pattern. IQ is an important consideration in this situation since it is assumed that individuals with a higher IQ can apply themselves more efficiently to the reading task. Since students in the pacing and freehand groups were habituated through training to read as fast as possible, their EEGs reflected a high frequency, low amplitude pattern. The control group evidently did not put forth as much mental effort, which resulted in EEG patterns of lower frequency and higher amplitude. The statistical analysis revealed this difference as a significant interation between the control group and the two experimental treatment groups by IQ.

The average IQ scores for the treatment groups were very similar. The mean for the control group was 95.50, for the pacing group 96.63, and for the freehand group 97.50. The average IQ score by sex differed slightly with the mean for males being 100.33 and for females 92.75. The average IQ score for treatment by sex ranged from 92.50 for females in the control group to 102.00 for males in the freehand group. None of the differences in mean IQ scores, however, were significant. The students were assigned to treatment groups at random by high and low IQ and sex. The dividing line between high and low IQ scores was 100.00 for boys and 98.0 for girls. The low IQ students

in the pacing group increased their reading rate 64.3 percent compared to 52.1 percent for the high IQ students. The low IQ students in the freehand group increased their reading rate 53.6 percent compared to 37.5 percent for the high IQ students. Although the average gain in WPM for the high IQ students was 30.3 and only 16.9 for the low IQ students, percentage wise, rapid reading instruction proved more beneficial to the low IQ group.

Implications for Education

The results of this study give a strong indication that an increase in braille reading rate can result from a short period of specifically planned lessons using either the pacing or freehand methods of instruction. The freehand method uses no special equipment or materials and is easier to administer. The pacing technique requires much prerecorded material and the use of recorders and variable speed speech machines. No significant loss of comprehension of braille was noted as reading rates improved for young, school aged blind students.

Educators for the blind, while being aware that the braille reading process is extremely slow, have according to Umsted (1970), put forth little demand or effort to insure that maximum reading speed has been attained by the time high school is reached. Apparently educators have assumed that reading instruction in braille is not necessary after elementary school.

Henderson (1967) and Umsted (1970) have shown that braille readers could profit from a sequential program of code recognition training. It was apparent from the experience of the current study

that some students in the freehand group lacked the ability to consistently recognize braille signs not encountered frequently. This drawback did not occur in the pacing group, since immediate feedback was available from a recording if the student did not recognize a sign. By utilizing a program of braille code recognition training prior to rapid reading instruction, students would receive a double benefit. Umsted (1970) concluded:

> The need for consistent instruction in reading skills is readily apparent, but the necessity for individualized instruction in accuracy and rate of recognition of the code members also appears essential in development of good braille reading (p. 41).

The majority of the students in the study were enthusiastic and self-motivated throughout the training period. They were conscientiously concerned about their braille reading ability and realized the advantages of being able to read faster. Individual improvement and growth were continuously emphasized. A positive attitude was desired and stressed. Each student was encouraged to obtain as much profit as possible from the opportunity, the available time, the materials and the individualized attention which were provided. The effects of self-improvement were nurtured with day-to-day progress reports serving as additional motivation and reinforcement.

In view of the results of this study it would be advantageous for educators of the visually handicapped to conduct yearly evaluations of the reading rate and comprehension for students using braille as their primary reading mode. A determination could then be made whether each student would benefit from a short period of rapid reading instruction. Progress in education has been described as a series

of plateaus, but in reading a final level is usually reached during the junior high school years. "Without instruction in the upper educational levels, reading skills achieved in the elementary school may deteriorate (Committee on Diagnostic Reading Tests, 1968, p. 15)." This study implied that by using specially designed techniques and materials, the speed and efficiency of the braille reading process may be improved for many braille readers.

Implications for Research

The statistically significant results of the present study support the need for further research to increase the rate and improve the efficiency of reading by braille. The philosophy currently prevalent in the education of the blind is to enter visually handicapped students in regular public schools as early as their academic development will allow. To successfully compete with sighted students in the reading of text and resource material without spending countless extra hours, braille readers need to at least double, if not triple, their reading rates.

1. Longitudinal studies of students who receive rapid reading instruction are necessary to determine whether gains in reading speed are maintained, increase further, or regress to former levels. The desired number of lessons and the amount of time necessary for each lesson may need to vary in order to optimally meet individual student needs in the most efficient manner.

2. The effects of motivation and reinforcement upon students engaged in rapid reading instruction in braille should be investigated further. The factor of motivation is of unquestionable importance as

shown by the studies of Kederis, Nolan and Morris (1967), and Maxwell and Mueller (1967).

3. A major problem encountered in the current study was the difficulty in locating tests for measuring the reading rate and comprehension of elementary school age blind students. Braille reading tests in more than one form that are suitable for use with younger children are not available. Present reading tests need to be adapted for the blind, or new tests developed and standardized in alternate forms, to facilitate the testing of rate and comprehension of braille readers from the second through the eighth grades.

4. There was no reported research in which a technique resembling the pacing method of rapid reading instruction was utilized for increasing reading rate. In light of recent technology in variable speed control devices for use with cassettes and reel-to-reel tape recorders, this method holds much promise as an avenue to help blind readers learn to recognize and decode braille characters at a faster pace. Research replicating the current study is needed to determine if the pacing method is actually superior to the freehand method for increasing the rate of reading braille for school age blind children.

5. Comprehension appears to hold fairly constant in studies designed to increase the rate of reading braille material. Tremonti (1964) found that the sighted improved comprehension 10 to 21 percent when a variety of techniques and materials were used. Research focusing on the nervous system mechanisms that perceive and interpret braille information as a person reads tactually needs to be enacted. Then methods could be developed for improving comprehension at the same time reading rates are being increased.

6. More sophisticated technology could be employed in conjunction with EEG equipment to determine shifts in cerebral hemispheric dominance during rapid reading in braille. If shifts were detected along with a significant increase in reading rates, a major educational milestone would be achieved. Training programs could then be designed to allow as many braille readers as possible to take advantage of this phenomenon.

Chapter 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The reading of braille, when compared with print reading, is a slow and tedious process. Blind students who use braille as their primary reading modality are educationally handicapped, since they read approximately one-third as fast as their sighted peers and do not get the benefit of pictures. Rapid reading instruction in braille for adults and high school age students resulted in significant increases in reading rates with no loss in comprehension (McBride, 1974; Wallace, 1973). Further research to increase the reading rates of school age blind children has been recommended (Wallace, 1973).

The purpose of this study was to determine the effects of pacing and freehand methods of rapid reading instruction in braille on measures of reading rate and comprehension for blind, school age students. Subjects were limited to those attending residential and public schools in Weber County, Utah, during the 1975-1976 school year. An additional purpose was to determine the effect of rapid reading instruction on the hemispheric EEG patterns of these students. Four hypotheses were tested during the course of this investigation:

1. There will be no significant difference in the mean gain of braille reading rates for blind students among the control, pacing or freehand treatment groups as measured by the Diagnostic Reading Test.

2. There will be no significant difference in the mean gain of braille reading comprehension for blind students among the control, pacing or freehand treatment groups as measured by the Diagnostic Reading Test.

3. There will be no significant difference in hemispheric dominance in electroencephalogram patterns for blind students among the control, pacing or freehand treatment groups as measured by an electroencephalograph.

4. There will be no significant interaction among methods of instruction, intelligence quotient (IQ), and sex for those blind students participating in the study.

Twelve male and twelve female blind students enrolled in schools in Weber County, Utah, were selected and assigned at random by IQ and sex to a control group and two experimental treatment groups. The Slosson Intelligence Test was administered to determine the IQ of each subject and all were pretested for reading rate and comprehension using the Diagnostic Reading Test. An EEG was recorded for all students while reading braille at their normal rate. One group was taught rapid reading of braille using the pacing method of instruction and a second group was taught using the freehand method. The third group acted as a control and received no instruction.

Daily lesson plans were followed for a five week period in an attempt to increase the braille reading rate and comprehension of the treatment groups. At the completion of the treatment period, all groups were posttested using an alternate form of the Diagnostic Reading Test. Individual EEG patterns were recorded while subjects

read as rapidly as possible. Brain wave patterns were analyzed to determine if a shift in hemispheric dominance from left to right had occurred during rapid reading instruction. Specific findings resulting from the various analyses performed in this study and pertaining to the four hypotheses were:

1. There was a significant difference at the .006 level of confidence in braille reading rates of blind students between the control group and the pacing and freehand treatment groups. Students in the pacing and freehand groups read significantly faster following training in rapid reading instruction than students in the control group. There was no significant difference in reading rates between the pacing and freehand groups. A comparison of reading rate means in WPM between the pretest and posttest showed 56.15 and 58.86 for the control group, 42.31 and 66.08 for the pacing group, and 56.16 and 79.58 for the freehand group.

2. There was no significant difference in braille reading comprehension of blind students among the control, pacing and freehand methods of instruction. A paring of comprehension means in percents between the pretest and posttest showed 62.13 and 67.00 for the control group, 60.38 and 65.38 for the pacing group, and 79.38 and 72.13 for the freehand group.

3. There was no significant difference in hemispheric dominance in EEG patterns of blind students among the control, pacing and freehand methods of instruction.

4. There were significant interactions among the independent variables in the following listed areas.

a. Among treatment, IQ and sex for pretest braille reading rates. ($p < .10$)

b. Between treatment and IQ for pretest EEG patterns. ($p < .035$)

c. Between IQ and sex for pretest EEG patterns. ($p < .06$)

d. Between treatment and IQ for posttest EEG patterns. ($p < .008$)

e. Between treatment and sex for posttest EEG patterns. ($p < .06$)

f. Between treatment and IQ for EEG pattern change. ($p < .025$)

g. Between treatment and sex for EEG pattern change. ($p < .075$)

Significant interactions and those approaching significance were plotted as Figures 1 through 9 in Chapter 3. Other mean score trends which were noted in the analyses as being statistically significant were also explained in the results section (Chapter 3) of the study.

Conclusions

The conclusions of this study were limited to the population of the study, the procedures used to gather the data, and the statistical analyses of the data. Based on the findings of this study, the following conclusions were drawn:

1. Rapid reading instruction in braille by either the pacing or freehand methods of instruction can significantly increase the

reading rates of school age blind children. Although there is no significant difference between the two techniques, the percentage increase in mean reading rate slightly favors the pacing method.

2. Comprehension of braille material does not change significantly for students receiving rapid reading instruction by either the pacing or freehand methods. Since reading rates increased for students in the pacing and freehand groups, no loss in comprehension was considered a positive factor in favor of rapid reading instruction.

3. No shift in cerebral hemispheric dominance in EEG patterns is evident from the data accumulated on students participating in the three treatment groups. An anticipated change from left to right in the area of the brain handling the reading function does not take place during rapid reading in braille at the rates achieved in this study.

4. Slightly significant interactions may occur between treatment groups by IQ and by sex for pretest reading rates. Mean scores may vary widely by sex for students with a high IQ. Significant interactions may take place with the analyses of EEG patterns while reading braille. Since there was no change in the main effect of hemispheric dominance, the only attempt to interpret EEG pattern interaction was done graphically without the drawing of conclusions. This is consistent with other EEG research where the effect of IQ and sex on EEGs is still not understood (Hartlage, 1973).

Recommendations

Recommendations evolving from the study are as follows:

1. A five week course of rapid reading instruction in braille, using either the pacing or freehand methods, would be valuable for blind students in the state of Utah upon entering junior high school. Rapid reading instruction should be a required part of their courses of study.

2. Comprehension of subject matter should be stressed as a necessity during rapid reading instruction in braille. This study indicated that comprehension need not suffer as braille reading rates increase.

3. Rapid reading instruction in braille is effective for high and low IQ blind students of both sexes. Individuals need not be excluded from a training program because of sex if they possess educable mental ability.

4. Yearly evaluation of the reading rate and comprehension of students using braille as their primary reading mode is recommended. This data would provide a longitudinal record of progress, and guidelines for expected levels of achievement at various ages could be determined.

5. Further research is needed in the area of hemispheric dominance during braille rapid reading training. A shift in cerebral dominance during very high reading speeds would have profound educational potential.

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APPENDIXES

APPENDIX A

Relevant Communications

UTAH SCHOOL FOR THE BLIND

Ogden, Utah

1 November 1975

Dear Parents:

Your child has been selected to participate in a special training program to increase his (her) rate of reading. This project will last approximately five weeks and instruction will be given for one hour after regular school hours. Day students will be transported home by the program coordinator.

Reading tests will be given before and after the training period to determine the amount of gain in reading rate and to see if comprehension was affected. There are indications that as the rate of reading increases, a shift occurs in the area of the brain controlling this function. We would, therefore, like to make electroencephalograms of each student prior to and following the training to see if any change is apparent. If so, improved techniques for reading could be devised to capitalize on this phenomenon.

An electroencephalogram (EEG) is a recording of brain wave patterns. The procedure is simple and causes no discomfort or pain. In our procedure four electrodes will be taped to the student's head and brain waves recorded while the student reads. Your child will probably enjoy the experience.

If you would like your child to participate in this program, please sign and return the enclosed form in the envelope provided. We are sure that this reading instruction will be beneficial for those who take part.

Sincerely,

George G. Howell
Reading Program Coordinator

This study has the approval of the administration of the Utah School for the Blind.

Robert W. Bischoff
Principal

CONSENT FORM

I give my permission for ______________________________ to participate in the special reading program to be conducted at the Utah School for the Blind during the 1975-1976 school year.

I understand that this involves measurements on an electroencephalograph (EEG) before and after training in reading.

______________________ ______________________________
Date Signature of Parent or Guardian

6 November 1975

Director
American Fork Training School
American Fork, Utah 84003

Dear Sir:

The Utah School for the Blind is allowing me to conduct a special training program in the reading of braille. The objective is to increase the braille reading rate while maintaining a high level of comprehension. The average braille reader has a reading rate of less than 100 words per minute. A significant increase in the reading rate of braille would have a profound effect upon the educational achievement of blind students.

Dr. Dillon Inouye of California and Dr. Bruce Brown of B.Y.U. have found indications that the reading function may shift from the left cerebral hemisphere to the right hemisphere when reading rates show a pronounced increase.

Braille reading students in grades five through twelve attending the Utah School for the Blind and Weber County public schools will be given special instruction to increase their braille reading rates. Prior to and following this training period we would like to make a recording of brain wave patterns using an electroencephalograph. It is hoped that by using a procedure reported by Callaway and Harris, we can determine if there has been a shift in hemispheric dominance during the training.

Would the EEG equipment at the American Fork Training School be available to make EEG recordings of about twenty-five students before and after our training program? We have checked with the McKay and St. Benedict Hospitals in Ogden and the cost is prohibitive. Dr. John Crandell of B.Y.U. suggested that your school may be able to help out in this project. Please let us know if this is possible.

Sincerely,

George G. Howell
Reading Program Coordinator

UTAH STATE TRAINING SCHOOL

American Fork, Utah 84003

December 8, 1975

George G. Howell
Reading Program Coordinator
Utah Schools for the Deaf and the Blind
846 Twentieth Street
Ogden, Utah 84401

Dear Mr. Howell:

We read with interest your recent letter regarding your special training program in the reading of braille and we would be happy to make our equipment available to you for EEG recordings before and after your training program.

We look forward to working with you in this project and will expect to hear from you when your plans are completed.

Sincerely,

Paul S. Sagers, Ed.D.
Superintendent

PSS:ha

25 March 1976

Grass Instrument Company
Quincy, Mass. 02169

Gentlemen:

Please send me one EEG ruler which can be used to measure amplitude and frequency of brain wave cycles.

If there is a charge for this item, please bill me and I will immediately send payment.

Very truly yours,

George G. Howell
Reading Program Coordinator

GRASS INSTRUMENT COMPANY

Quincy, Mass. 02169

The enclosed material is sent to you in response to your recent request as part of the Grass educational support program in electroencephalography.

There is no charge for this educational material, and we sincerely hope you will find it both interesting and useful.

Please do not hesitate to get in touch with us whenever you feel we can be of additional help.

We consider this program an essential part of Grass Instrument Company contribution to the long term goal we all share . . . that of improved technological excellence in EEG.

APPENDIX B

Pacing Method Lesson Plans

Day 1

1. Introduce students to the pacing method of rapid reading instruction in braille.

2. Explain that the goal of this program is to increase the reading rate of each student without a loss in comprehension.

3. Administer the pretest and note the students' reading patterns. List the results on the Reading Test Record Sheet (Figure 10, Appendix D).

Day 2

1. Stress again the goal of the rapid reading program.

2. Play prerecorded tape outlining ways to increase braille reading rate. Discuss the following ideas:

   a. Reading with more fingers.

   b. Reading with both hands.

   c. Stopping subvocalization.

   d. Moving faster across the words.

   e. Increasing tactile imagery.

   f. Establishing comfortable reading position.

   g. Practicing independent movement of hands.

   h. Reducing pressure on finger tips.

   i. Sharing new reading techniques.

3. Demonstrate the operation of a cassette recorder with the variable speed control machine.

4. Check out a cassette recorder and elementary level braille books with matching prerecorded tapes to each student. List these items on the Check-Out Record (Figure 12, Appendix D).

Day 3

1. Take roll and record on the Individual Roll and Record Sheet (Figure 11, Appendix D). Review goal of the reading program.

2. Have students practice reading while listening to tapes of the same material. Play tapes slightly faster than normal reading rate. Take timings and record braille reading rates.

3. As students become able to keep pace with the recorded material, speed up the cassette player a few words per minute.

4. Commit students to at least one hour of practice time each day outside of the training session. Suggest it be broken into two or three segments by changing activities or practicing at different times during the day.

Day 4

1. Take roll and record the amount of practice time for each student since the last training session. Remind students of the goal of the reading program.

2. Have students share reading techniques and hand positions they have found helpful. Try to develop an enthusiastic and positive attitude among the participants.

3. Start individual reading practice and take a timing for each student. Record reading rate and compare with previous day. Questions should be answered freely during the training and much encouragement given to students to read faster.

4. Comment on the importance of practice outside of the formal reading sessions. Increasing the rate of reading and maintaining the faster rate takes consistent effort.

Day 5

1. Take roll and record the practice time for each student. Ask students to give the goal of the reading program and to explain why it is important to them to increase their reading rates.

2. Review the techniques for increasing braille reading rates discussed on the second day. Urge the students to experiment and try to find ways of covering the braille cells faster to make their reading more efficient.

3. Have students begin individual reading practice with tapes speeded up enough to offer a challenge to keep pace. Take timings and compare with previous rates. Compliment students for improvement.

4. Encourage personal practice time and have pupils specify materials they would like recorded on cassette tapes by volunteer readers.

Day 6

1. Take roll and record practice time. Review the goal of the reading program.

2. Pass out newly recorded materials and list on the Check-Out Record.

3. Begin individual reading practice and urge faster and faster reading. Take timings and compare with previous results.

4. While practicing by themselves, students should take time after each reading to mentally review the material covered.

Day 7

1. Take roll and record practice time. Stress the goal of the reading program.

2. Discuss reading as a function of habit. Individuals most likely follow the same general pattern whenever they read. In order to read faster, new habits must be formed. Encourage further experimentation with faster ways of covering all braille characters on each page.

3. Start individual reading practice. Take timings and record reading rates in words per minute.

4. Commend students who are reporting much individual practice outside of the training sessions. Urge other students to practice at least one hour per day.

Day 8 Through Day 24

A general lesson plan covering Day 8 through Day 24 is outlined below:

1. Take roll and record braille reading practice time on the Individual Roll and Record Sheet. Review the goal of the reading program.

2. Discuss any questions or problems the students may have. Pass out newly recorded material and determine what other reading the students need recorded. Students are to now read material corresponding to their own reading grade level. Students may read the same material more than once.

3. Begin individual reading practice, take timings in WPM, and record the reading rates for each student. Urge students to

press for faster reading rates. Compare current braille reading rates with previous rates to give immediate feed-back on student progress. Have students periodically increase the speed of the recorded material and adjust their reading rates to keep pace.

4. Encourage students to practice the pacing method of reading on their own time. Comprehension will be improved if students mentally review the material after it is read. Continually maintain a positive and enthusiastic attitude regarding the reading program.

Day 25

1. Take roll and record practice time.

2. Administer the posttest and list the results on the Reading Test Record Sheet.

3. Advise students of their current reading rates and compare with their beginning rates. Urge students to strive to maintain, if not improve, their present reading rates. Express appreciation to students for their participation in the reading program.

APPENDIX C

Freehand Method Lesson Plans

The lesson plans for the freehand method of instruction closely paralleled those of McBride (1974) and Wallace (1973). They were modified somewhat to allow for a longer training period and for use with younger subjects. Table 13 details levels of comprehension used in conjunction with freehand reading instruction.

Table 13

Levels of Comprehension

Comprehension Level	Percent of Comprehension
Speed Only	None
Disconnected Bits and Pieces	0-19
Connected Bits and Pieces	20-39
Plot	40-59
General	60-79
Full	80-100

Day 1

1. Introduce students to the freehand method of rapid reading instruction in braille.

2. Explain that the goal of this program is to increase the reading rate of each student without a loss in comprehension.

3. Administer the pretest and note the students' reading patterns. List the results on the Reading Test Record Sheet (Figure 10, Appendix D).

Day 2

1. Stress again the goal of the rapid reading program.

2. Play prerecorded tape outlining ways to increase braille reading rate. Discuss the following ideas:

   a. Reading with more fingers.

   b. Reading with both hands.

   c. Stopping subvocalization.

   d. Moving faster across the words.

   e. Increasing tactile imagery.

   f. Establishing comfortable reading position.

   g. Practicing independent movement of hands.

   h. Reducing pressure on finger tips.

   i. Sharing new reading techniques.

3. Practice reading for speed only, with no comprehension. During this process the hands move so that all words are encountered, but no meaning is gathered from the words.

4. The sequence of timings for this day is found in Table 14. Encourage students to turn pages rapidly while working with easy, low-level material. Also encourage faster and faster reading.

5. Commit students to at least one hour of practice time each day outside of the training session. Explain that the time will be most efficiently used when divided into several parts, as the fatigue factor makes this necessary in most cases. Check out braille materials to students on Check-Out Record (Figure 12, Appendix D).

Table 14

Day 2 Timings

Repetitions	Time	Comprehension	Comments
4	10 sec	Speed only	Same page
2	Less than 10 sec	Speed only	Same page
2	20 sec	Speed only	Two new pages
2	Less than 20 sec	Speed only	Same pages
2	30 sec	Speed only	As many pages as possible

Day 3 and Day 4

1. Take roll and record practice time on the Individual Roll and Record Sheet (Figure 11, Appendix D). Remind students of the goal of the reading program.

2. Have students share reading techniques and hand positions they have found helpful. Try to convey an enthusiastic and positive attitude.

3. Conduct sequence of timed readings as listed in Table 15. While reading for disconnected bits and pieces, comprehension amounts to only a few words gathered with no continuity of thought. Ask students what words they have picked up after each timing. Questions should be answered freely during the training and much encouragement given to students to read faster.

4. Encourage individual practice time and suggest it be broken into segments by changing activities or practicing at different times during the day.

Table 15

Day 3 and Day 4 Timings

Repetitions	Time	Comprehension	Comments
5	30 sec	Speed only	Same material
2	1 min	Speed only	Same material, faster
1	1 min	Disconnected bits and pieces	Same material
1	1 min	Speed only	New material
1	1 min	Speed only	Same material

Day 5 and Day 6

1. Take roll and record the amount of practice time for each student since the last training session. Review goal of the program.

2. Have students share experiences. Continue to build enthusiasm and confidence. Discuss different ways of moving the hands across the page and urge students to experiment.

3. Begin timed readings as contained in Table 16. Connected bits and pieces comprehension is knowing several related ideas from the material read.

4. Home practice should follow the pattern of the final three timings in Table 16. Remind students to keep increasing reading speed.

Table 16

Day 5 and Day 6 Timings

Repetitions	Time	Comprehension	Comments
1	1 min	Speed only	New material
3	1 min	Speed only	Same material, faster
1	1 min	Disconnected bits and pieces	Same material
2	1 min	Disconnected bits and pieces	New material
1	1 min	Connected bits and pieces	Same material
1	1 min	Speed only	New material
1	1 min	Disconnected bits and pieces	Same material
1	1 min	Connected bits and pieces	Same material

Day 7 and Day 8

1. Take roll and record braille reading practice time. Stress the goal of the reading program.

2. Discuss reading as a function of habit. Individuals most likely follow the same general pattern whenever they read. In order to read faster, new habits must be formed. Encourage further experimentation with faster ways of covering all braille characters on each page.

3. Start the timed readings listed in Table 17. Plot comprehension, the next higher level of comprehension, is fitting the

material into a general course of action. At this point the reader begins to ascertain an understanding of the material.

4. After trials for any level of comprehension above speed only, ask students to relate any information gained from the reading. Urge students to continue practicing at home.

Table 17

Day 7 and Day 8 Timings

Repetitions	Time	Comprehension	Comments
3	1 min	Speed only	New material
1	1 min	Disconnected bits and pieces	Same material
1	1 min	Connected bits and pieces	Same material
1	1 min	Plot	Same material
2	1 min	Speed only	New material
1	1 min	Disconnected bits and pieces	Same material
1	1 min	Connected bits and pieces	Same material
1	1 min	Plot	Same material
2	1 min	Speed only	New material
1	1 min	Connected bits	Same material
1	1 min	Plot	Same material

Day 9 and Day 10

1. Take roll and record braille reading practice time. Ask students to give the goal of the rapid reading program.

2. Have students share success experiences that have enabled them to increase their rate of encountering every braille word. Mention the reading rates achieved by other visually handicapped people when taught by McBride (1974).

3. Begin series of timed readings contained in Table 18. The review level of comprehension involves going over the same material checking only the sections missed previously. Compute and record informal reading rates on the Individual Roll and Record Sheet (Figure 11, Appendix D) for readings involving plot comprehension.

4. While practicing by themselves, students should stop after each reading and mentally review the material covered.

Table 18

Day 9 and 10 Timings

Repetitions	Time	Comprehension	Comments
2	1 min	Speed only	New material
1	1 min	Connected bits and pieces	Same material
1	1 min	Plot	Same material
1	1 min	Review	Same material
1	1 min	Speed only	New material
1	1 min	Connected bits and pieces	Same material
1	1 min	Plot	Same material
1	1 min	Review	Same material
1	1 min	Connected bits and pieces	New material at fastest speed

Day 11, Day 12 and Day 13

1. Take roll and record reading practice time. Review goal of the reading program.

2. Discuss any questions or problems the students may have. Ask older students to begin using junior high school level reading material. Urge participants to continually strive to increase their reading speed.

3. Perform timed readings as outlined in Table 19. The general level of comprehension involves knowing the action of the story and understanding a few details of the story. Record informal reading rates for general comprehension.

4. Encourage practice time with students striving for general comprehension.

Table 19

Day 11, Day 12 and Day 13 Timings

Repetitions	Time	Comprehension	Comments
1	1 min	Speed only	New material
1	1 min	Connected bits and pieces	Same material
1	1 min	Plot	Same material
1	1 min	General	Same material
1	1 min	Connected bits and pieces	New material
1	1 min	Plot	Same material
1	1 min	General	Same material, keep speed up
1	1 min	Plot	New material

Table 19 (continued)

Repetitions	Time	Comprehension	Comments
1	1 min	Review	Same material
1	1 min	General	Same material
1	1 min	Speed only	New material
1	1 min	Plot	Same material
1	1 min	General	Same material, fastest speed

Day 14, Day 15 and Day 16

1. Take roll and record practice time. Stress the goal of the reading program.

2. Discuss progress and share experiences to maintain enthusiasm. Emphasize the value of continual experimentation for new reading patterns.

3. The timings for Days 14, 15 and 16 are found in Table 20. Full level comprehension is equivalent to the amount of knowledge necessary for a book report. Ask students to relate the information just read after each timing above the speed only level of comprehension.

4. During individual practice time, students should try to achieve the full level of comprehension.

Table 20

Day 14, Day 15 and Day 16 Timings

Repetitions	Time	Comprehension	Comments
1	1 min	Speed only	New material
1	2 min	Plot	Same material
1	1 min	Review	Same material
1	1 min	General	Same material
1	1 min	Connected bits and pieces	New material
1	1 min	Plot	Same material
1	1 min	General	Same material
1	2 min	Full	Same material
1	1 min	Plot	New material
1	2 min	Full	Same material
1	1 min	General	New material
1	2 min	Full	Same material

Day 17, Day 18 and Day 19

1. Take roll and record practice time. Stress the goal of the reading program.

2. Discuss progress and have students share experiences.

3. Follow the sequence of timings in Table 21. Record the informal reading rates for full comprehension.

4. Encourage individual practice with each student striving to attain full comprehension.

Table 21

Day 17, Day 18 and Day 19 Timings

Repetitions	Time	Comprehension	Comments
1	1 min	Speed only	Warm-up
1	1 min	General	New material
1	2 min	Full	Same material, keeping speed up
1	1 min	General	New material
1	2 min	Full	Same material
1	1 min	Review	Same material
1	1 min	Speed only	New material
1	1 min	General	Same material
1	1 min	Connected bits and pieces	New material
1	1 min	Full	Same material, fast speed

Day 20 Through Day 24

1. Take roll and record practice time. Stress the goal of the reading program.

2. Discuss progress and have students share experiences.

3. Take timings in accordance with Table 22 and record informal reading rates.

4. Encourage individual practice with each student striving to achieve full comprehension.

Table 22

Day 20 Through Day 24 Timings

Repetitions	Time	Comprehension	Comments
1	1 min	Speed only	Warm-up
1	1 min	General	New material
1	2 min	Full	Same material
1	1 min	General	New material
1	2 min	Full	Same material
1	1 min	Speed only	New material
1	1 min	Full	Same material
1	2 min	Full	New material, maintain speed
1	3 min	Full	New material

Day 25

1. Take roll and record practice time.

2. Administer the posttest and list the results on the Reading Test Record Sheet.

3. Advise students of their current reading rates and compare with their beginning rates. Urge students to strive to maintain, if not improve, their present reading rates. Express appreciation to students for their participation in the reading program.

APPENDIX D

Record Sheets

Figure 10

Reading Test Record Sheet

Pretest/Posttest

							COMPREHENSION		
Student Name	Test	Form	Level	Time Elapsed	Words Read	Rate WPM	Number of Questions	Number Correct	Percent Correct

Figure 11

Individual Roll and Record Sheet

PACING METHOD

Name	Date			Date			Date		
	ATT	IPT	WPM	ATT	IPT	WPM	ATT	IPT	WPM
P1									
P2									
P3									
P4									
P5									
P6									
P7									
P8									
		FREEHAND METHOD							
F1									
F2									
F3									
F4									
F5									
F6									
F7									
F8									

LEGEND: ATT = Attendance; / = Late, X = Absent

IPT = Individual practice time

WPM = Words per minute

Figure 12

Check-Out Record

Date	Name	Book or Tape	Machine Number	Model Number	Date In

4 Track - Model 3-5192

2 Track - Model M 8355A

VSC - Model 0710

APPENDIX E

Means and Cell Sizes

Table 23

Means and Cell Sizes for Reading Rates

Source	Level	N	Pretest	Posttest	Gain	Adj Gain
Treatment	Control	8	56.15	58.86	2.71	1.82
	Pacing	8	42.31	66.08	23.77	25.56
	Freehand	8	56.16	79.58	23.42	22.51
IQ	High	12	71.13	91.03	19.90	16.10
	Low	12	31.96	45.31	13.35	17.16
Treatment x IQ	Con High	4	73.75	72.88	- .87	- 5.20
	Con Low	4	38.55	44.85	6.30	8.83
	Pace High	4	56.35	85.70	29.35	28.41
	Pace Low	4	28.28	46.45	18.17	22.71
	Free High	4	83.28	114.52	31.24	25.07
	Free Low	4	29.05	44.63	15.58	19.96
Sex	Male	12	60.68	78.40	17.72	15.94
	Female	12	42.40	57.94	15.54	17.32
Treatment x Sex	Con M	4	53.60	55.83	2.23	1.82
	Con F	4	58.70	61.90	3.21	1.81
	Pace M	4	60.88	84.03	23.15	21.33
	Pace F	4	23.75	48.13	24.38	29.79
	Free M	4	67.58	95.35	27.77	24.65
	Free F	4	44.75	63.80	19.05	20.37
IQ x Sex	High M	6	88.17	108.42	20.25	13.12
	High F	6	54.08	73.65	19.57	19.07
	Low M	6	33.20	48.38	15.18	18.76
	Low F	6	30.72	42.23	11.51	15.57
Treat x IQ x Sex	C H M	2	64.20	59.20	- 5.00	- 7.47
	C H F	2	83.30	86.55	3.25	- 2.93
	C L M	2	43.00	52.45	9.45	11.11
	C L F	2	34.10	37.25	3.15	6.55
	P H M	2	97.10	124.50	27.40	18.53
	P H F	2	15.60	46.90	31.30	38.30
	P L M	2	24.65	43.55	18.90	24.14
	P L F	2	31.90	49.35	17.45	21.28
	F H M	2	103.20	141.55	38.35	28.29
	F H F	2	63.35	87.50	24.15	21.85
	F L M	2	31.95	49.15	17.20	21.02
	F L F	2	26.15	40.10	13.95	18.90

Table 24

Means and Cell Sizes for Comprehension

Source	Level	N	Pretest	Posttest	Gain	Adj Gain
Treatment	Control	8	62.13	67.00	4.87	2.97
	Pacing	8	60.38	65.38	5.00	2.45
	Freehand	8	79.38	72.13	-7.25	-2.79
IQ	High	12	74.83	71.92	-2.91	-0.13
	Low	12	59.75	64.42	4.67	1.88
Treatment x IQ	Con High	4	67.75	69.50	1.75	1.92
	Con Low	4	56.50	64.50	8.00	4.02
	Pace High	4	70.75	72.75	2.00	3.28
	Pace Low	4	50.00	58.00	8.00	1.62
	Free High	4	86.00	73.50	-12.50	-5.59
	Free Low	4	72.75	70.75	-2.00	0.14
Sex	Male	12	62.83	60.25	-2.58	-4.23
	Female	12	71.75	76.08	4.33	5.98
Treatment x Sex	Con Male	4	51.75	53.50	1.75	-3.99
	Con Female	4	72.50	80.50	8.00	9.92
	Pace Male	4	64.00	63.50	-0.50	-1.72
	Pace Female	4	56.75	67.25	10.50	6.61
	Free Male	4	72.75	63.75	-9.00	-6.99
	Free Female	4	86.00	80.50	-5.50	1.41
IQ x Sex	High Male	6	77.17	64.33	-12.84	5.80
	High Female	6	72.50	79.50	7.00	20.70
	Low Male	6	33.20	71.18	45.98	37.80
	Low Female	6	71.00	72.67	1.67	2.22
Treat x IQ x Sex	C H M	2	58.00	52.50	-5.50	-7.68
	C H F	2	77.50	86.50	9.00	10.76
	C L M	2	45.50	54.50	9.00	11.01
	C L F	2	67.50	74.50	7.00	5.32
	P H M	2	87.00	77.00	-10.00	-8.87
	P H F	2	54.50	68.50	14.00	12.08
	P L M	2	41.00	50.00	9.00	11.32
	P L F	2	59.00	66.00	7.00	6.11
	F H M	2	86.50	63.50	-23.00	-26.47
	F H F	2	85.50	83.50	-2.00	-3.50
	F L M	2	59.00	64.00	5.00	7.83
	F L F	2	86.50	77.50	-9.00	-6.78

Table 25

Means and Cell Sizes for EEG Patterns

Source	Level	N	Pretest	Posttest	Gain	Adj Gain
Treatment	Control	8	1.97	.47	-1.50	-1.56
	Pacing	8	1.91	.50	-1.41	-1.53
	Freehand	8	2.21	.53	-1.68	-1.50
IQ	High	12	1.67	.13	-1.54	-1.15
	Low	12	2.40	.88	-1.52	-1.91
Treatment x IQ	Con High	4	.25	-.81	-1.06	-2.87
	Con Low	4	3.69	1.75	-1.94	-0.25
	Pace High	4	2.06	.69	-1.37	-1.34
	Pace Low	4	1.75	.31	-1.44	-1.72
	Free High	4	2.69	.50	-2.19	-1.52
	Free Low	4	1.75	.56	-1.19	-1.47
Sex	Male	12	1.96	.67	-1.29	-1.37
	Female	12	2.10	.33	-1.77	-1.70
Treatment x Sex	Con Male	4	2.06	.75	-1.31	-1.28
	Con Female	4	1.88	.19	-1.69	-1.85
	Pace Male	4	1.50	1.13	-0.37	-0.92
	Pace Female	4	2.31	-.13	-2.44	-2.15
	Free Male	4	2.31	.13	-2.18	-1.90
	Free Female	4	2.12	.94	-1.18	-1.09
IQ x Sex	High Male	6	2.42	.25	-2.17	-1.77
	High Female	6	.92	.00	-0.92	-2.15
	Low Male	6	1.50	1.08	-0.42	-0.96
	Low Female	6	3.29	.67	-2.62	-1.34
Treat x IQ x Sex	C H M	2	1.38	-.63	-2.01	-1.96
	C H F	2	-.88	-1.00	-0.12	-0.23
	C L M	2	2.75	2.13	-0.62	-0.73
	C L F	2	4.63	1.38	-3.25	-3.16
	P H M	2	2.88	.88	-2.00	-3.01
	P H F	2	1.25	.50	-0.75	-0.58
	P L M	2	.13	1.38	1.25	1.17
	P L F	2	3.38	-.75	-4.13	-4.32
	F H M	2	3.00	.50	-2.50	-2.36
	F H F	2	2.38	.50	-1.88	-1.95
	F L M	2	1.63	-.25	-1.88	-1.73
	F L F	2	1.88	1.38	-0.50	-0.68

Table 26

Means and Cell Sizes for IQ Scores

Source	Level	N	Pretest
Treatment	Control	8	95.50
	Pacing	8	96.63
	Freehand	8	97.50
Sex	Male	12	100.33
	Female	12	92.75
Treatment x Sex	Control Male	4	98.50
	Control Female	4	92.50
	Pacing Male	4	100.50
	Pacing Female	4	92.75
	Freehand Male	4	102.00
	Freehand Female	4	93.00

Table 27

Means, Standard Deviations and Gains for Reading Rates, Comprehension and EEG Patterns

Group	N	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD	Mean Gain	Percent Gain
		Reading Rates					
Control	8	56.15	27.25	58.86	26.98	2.71	4.8
Pacing	8	42.31	38.14	66.08	41.22	23.77	56.2
Freehand	8	56.16	36.98	79.58	51.76	23.42	41.7
		Comprehension					
		Pretest Mean	Pretest SD	Posttest Mean	Posttest SD		
Control	8	62.13	22.22	67.00	18.97	4.87	7.8
Pacing	8	60.38	25.50	65.38	18.97	5.00	8.3
Freehand	8	79.38	15.68	72.13	14.69	- 7.25	- 9.1
		EEG Patterns					
		Pretest Mean	Pretest SD	Posttest Mean	Posttest SD		
Control	8	1.97	2.37	.47	1.56	- 1.50	- 76.1
Pacing	8	1.91	2.28	.50	1.05	- 1.41	- 73.8
Freehand	8	2.21	1.71	.53	.92	- 1.68	- 76.0

APPENDIX F

Raw Data and Test Results

Table 28

Raw Data and Test Results

Subject	Sex	IQ	Age	Rate		Comprehension		EEG	
				Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
C1	F	107	14	99.5	95.5	73	73	-1.50	-2.25
C2	F	115	12	67.1	77.6	82	100	-0.25	0.25
C3	F	75	18	41.5	48.0	80	67	7.00	1.00
C4	F	73	13	26.7	26.5	55	82	2.25	1.75
C5	M	105	10	35.7	33.5	36	45	1.75	0.25
C6	M	119	21	92.7	84.9	80	60	1.00	-1.50
C7	M	92	12	23.5	24.5	73	73	3.25	2.75
C8	M	78	12	62.5	80.4	18	36	2.25	1.50
P1	F	98	11	17.2	70.7	27	46	2.00	0.50
P2	F	116	10	14.0	23.1	82	91	0.50	0.50
P3	F	75	20	42.6	53.7	73	82	7.00	-1.00
P4	F	82	14	21.2	45.0	45	50	-0.25	-0.50
P5	M	127	18	135.9	162.3	87	87	3.00	2.25
P6	M	131	13	58.3	86.7	87	67	2.75	-0.50
P7	M	69	12	32.5	58.2	18	36	-0.50	1.50
P8	M	75	17	16.8	28.9	64	64	0.75	1.25
F1	F	109	12	44.8	63.0	91	100	1.75	0.25
F2	F	104	15	81.9	112.1	90	67	3.00	0.75
F3	F	82	19	35.3	58.0	82	82	1.50	1.00
F4	F	77	17	17.0	22.2	91	73	2.25	1.75
F5	M	141	18	137.6	198.6	100	80	3.50	-0.25
F6	M	112	15	68.8	84.5	73	47	2.50	1.25
F7	M	90	14	20.9	36.7	45	64	1.25	-0.25
F8	M	65	15	43.0	61.6	73	64	2.00	-0.25

A COMPARISON OF PACING AND FREEHAND RAPID READING INSTRUCTION IN BRAILLE ON READING RATE AND COMPREHENSION OF SCHOOL AGE BLIND CHILDREN

George Gary Howell

Department of Educational Psychology

Ed.D. Degree, December 1976

ABSTRACT

The purpose of this study was to determine the effects of pacing and freehand methods of rapid reading instruction in braille on measures of reading rate and comprehension for 24 blind, school age students. Additionally, the effect of rapid reading instruction on their hemispheric electroencephalogram patterns was studied. An analysis of covariance was performed using gain scores in reading rate, comprehension, and EEG change patterns relative to methods of instruction, IQ and sex, and the interactions among methods, IQ and sex.

A significant increase in the reading rates of the two experimental groups over the control group was found, with the pacing group indicating a trend for a slightly greater increase in reading rate than the freehand group. There was no difference in comprehension or hemispheric dominance among the three treatment groups. Means for the pretest and posttest reading rates ranged from 42 to 80 WPM and comprehension ranged from 62 to 79 percent. It was concluded that either method of rapid reading instruction could be used to increase significantly the braille reading rates of school age blind children.

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HV1669 Howell, George Gary. c.1
H839 A COMPARISON OF PACING AND FREEHAND RAPID READING INSTRUCTION IN BRAILLE ON READING RATE AND COMPREHENSION...

Date Due (1976)

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